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VOL. LV
No. 1422

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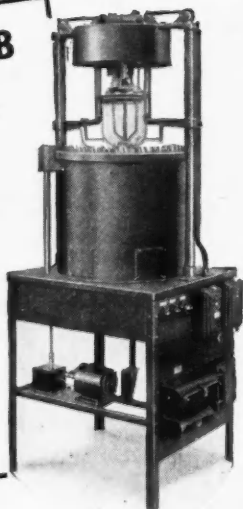
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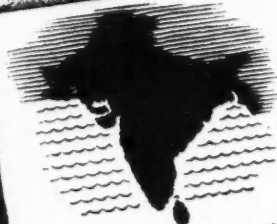
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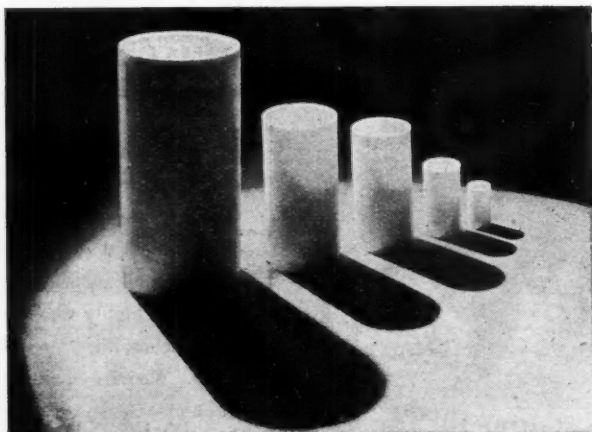
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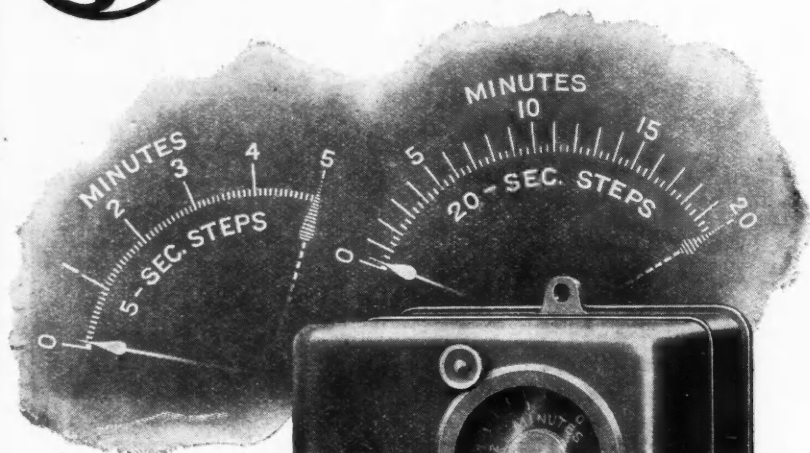
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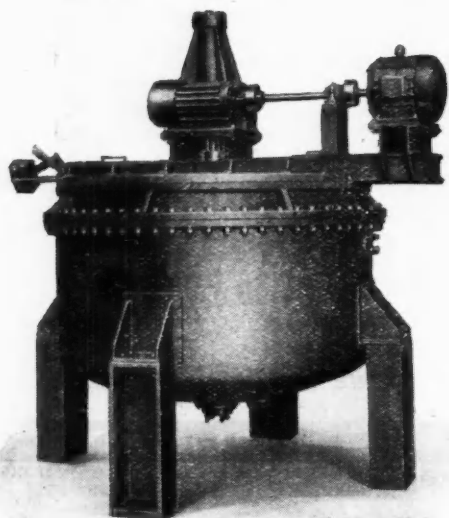
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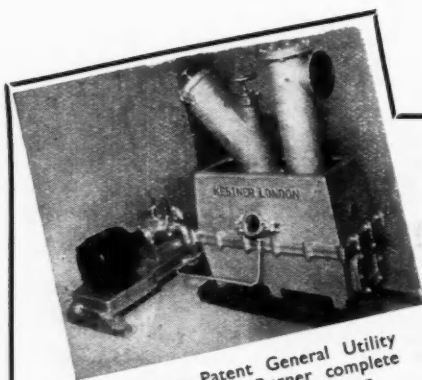
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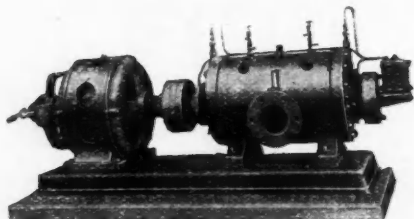
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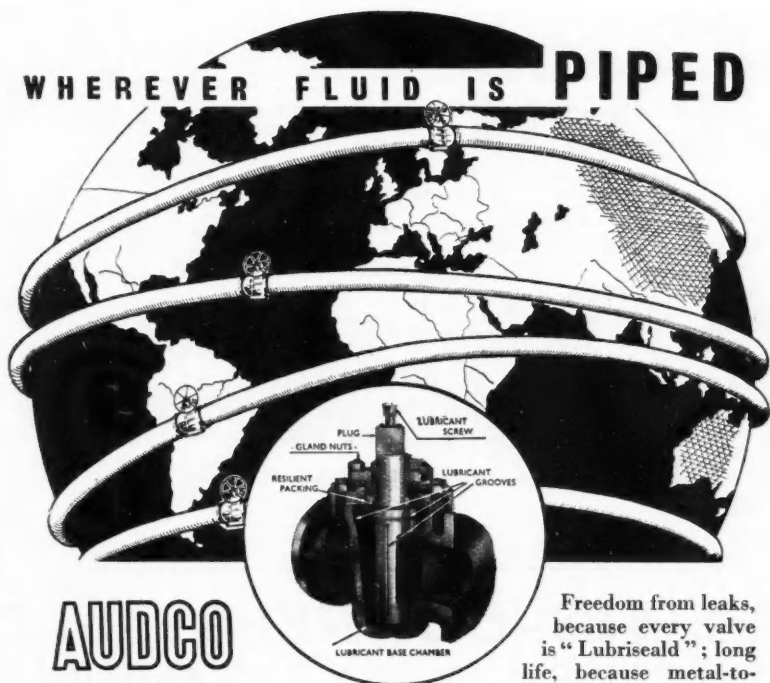
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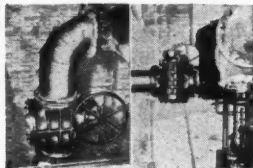
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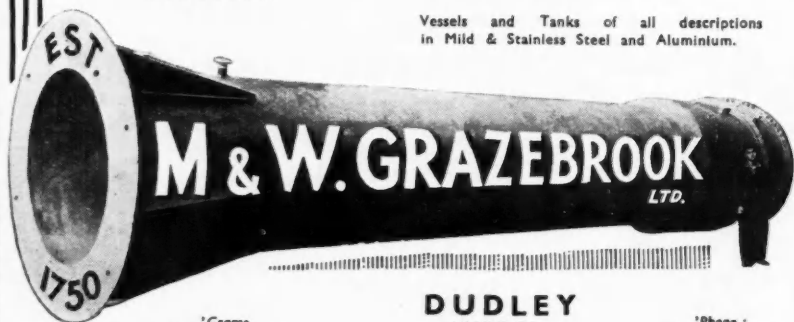
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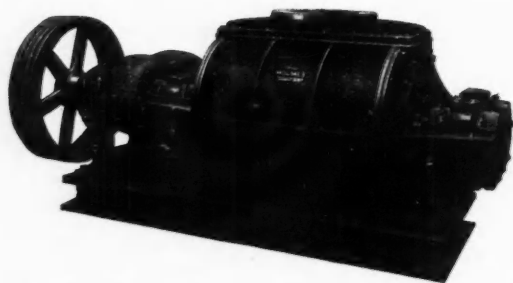


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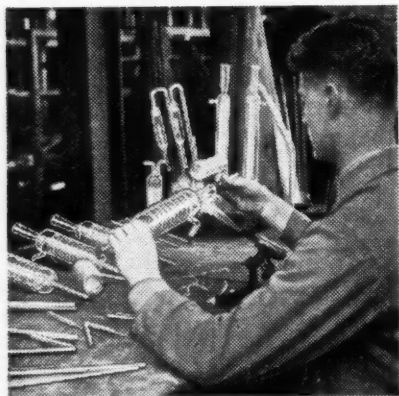
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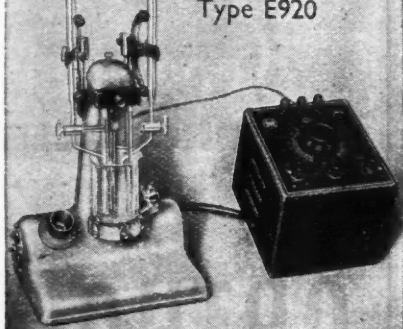
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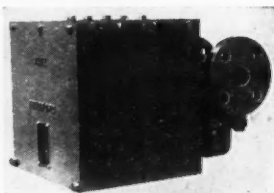
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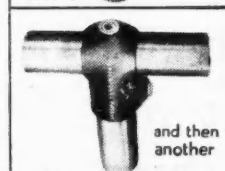
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Large-Scale Research

RESEARCH in the abstract is a pleasing subject. Research in the laboratory, where everything is well under control, is commonly an exact subject. Research on the large scale, where the investigator is at the mercy of conditions, is prone to be exasperating. It is only when the research man comes to investigate large-scale operations that he finds how very unsatisfactory the best-laid schemes may be in practice. Mathematically, problems become more difficult as the number of variables increases, and it does not require many variables before they become what mathematicians delight in calling "intractable." *Divide et impera* is a good rule in science as in war; but not infrequently it is impossible to divide problems into their components, and this is particularly true of large-scale problems.

An example of the difficulty of drawing conclusions from large-scale work is afforded by the latest D.S.I.R. publication connected with Fuel Research entitled: "Experiments on Coking Practice." The research was planned in a manner that would seem admirable to those without experience of large-scale investigations in by-product coking. A number of coals was selected for the purpose. On account of the outbreak of war in 1939, the full

programme could not be carried out, and only three of these coals were used. The full programme on these coals, however, appears to have been fulfilled. They were a Durham coking coal, a South Yorkshire coal from the Parkgate seam, and a South Wales coking coal. From these coals there was prepared a bulk washed and crushed "sample" sufficiently large to enable three complete ovens to be charged at each of six coking plants. The six plants possessed ovens of widely different design. That in itself would at one time have provoked considerable caution, because every oven-builder used to claim that his design was the best, and produced the best coke. Perhaps it is fair to accept to-day the view that every coke oven produces equally good coke when charged with the same coal; *perhaps* that is reasonable,

but when to this factor are added different lengths of time since the ovens were built, different handling, and the idiosyncrasies of different operators, it becomes a large assumption to believe that every one of these six plants, scattered all over the country from Scotland to South Wales, would be in equally good fettle. In point of fact the authors of the report show clearly that there were such variations, and that not every oven was equally perfect.

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Then let us mark the character of the ovens. In this we shall neglect the type of oven (which should not affect the problem if we accept our initial assumption) and concentrate on operating conditions. Given in order, we shall state (a) the mean width, (b) the mean height, and (c) the approximate mean operating flue temperature (in degrees Centigrade) 10 min. after reversal.

	(a)	(b)	(c)
Oven A	20 $\frac{1}{4}$ "	6' 10 $\frac{1}{4}$ "	1150°
Oven B	17 $\frac{3}{4}$ "	13' 9 $\frac{1}{2}$ "	1100°
Oven C	18"	11' 7"	1150°
Oven D	16"	12' 6"	1260°
Oven E	14"	11' 8"	1275°
Oven F	12"	11' 6"	1075°

Intermittent

vertical retorts	11"	16' 8"	1150°
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It will immediately be seen that several variables are added to the list. The ovens are of widely different widths. Simultaneously, they are operated at widely different temperatures. Simultaneously also, they are of very different heights, involving different pressures on the coking mass, and probably different compressions due to the heights dropped by the coal when charging. There may have been other simultaneous variables due to these causes or to other causes; such, for example, as different distribution of temperature due to differences in the method of regulation of the gas or to the height of the coal charge.

By this time, the reader may ask what was the purpose of the research. The answer is that it did not appear to have any clearly defined purpose. We read in the report that "as a first step . . . intended to serve as a guide in planning further investigations," it was decided "to determine the yields and properties of the cokes obtained by carbonising six coals in six types of industrial coke ovens of different width and in an intermittent vertical chamber oven." Not unnaturally, the results were almost entirely negative. The report states that "owing to the fact that the series of experiments was not completed and the data available refer to only three coals, no definite conclusions have been drawn from the results." The reason why no definite conclusions have been drawn, and in our view cannot be drawn (other than confirmation of known facts), is that there were too many simultaneous variables. This is not the place to discuss the results in detail, and we shall refer only to this research as an outstanding

proof that in large-scale work, as in the laboratory, the principle of *divide et impera* must be followed. If it is decided to investigate the effect of oven width upon shatter index, for example, there should be no other variable than oven width. If the temperature is to be varied, again there must be only that one variable. It will be admitted at once that research of this character is very expensive indeed since it means in effect building a battery of ovens specially for the test—a wholly uneconomic proceeding. It would not seem impossible, however, for arrangements to be made to reduce at any given time all variables but one to so small an amount as to enable them to be neglected.

When all is done, however, we must ask whether such experiments on by-product coke ovens are of very much value. Again and again in this report the conclusion is reached that the nature of the coal is of more consequence than the carbonising conditions. That is undeniable and suggests that the first variable to be considered is that of the nature of the coal. It would be a comparatively reasonable undertaking, with the backing of Government funds, to build a small battery of six or more ovens of different widths, and capable of being heated as desired to different flue temperatures, and to investigate in them the behaviour of many different coals. In that way it would be possible to determine which oven width and temperature would produce from coals of various characters the best kind of coke for particular purposes. The cokes produced might be tested in large-scale practice. Large-scale research is full of difficulties, difficulties which often arise from economic causes. Sometimes there is a short cut to success. Sometimes there is no short cut. When this happens, as appears to have happened with this attempt at coke-oven research, it is necessary to determine whether the information to be obtained from the research is worth the money that must be expended upon it. Our own view is that a much more modest programme can be drawn up, capable of being carried into effect with far less expenditure and without the need for building a full battery of coke ovens. The conclusions that are drawn from the modest experiments can then be tried out on the full manufacturing scale. But at least let us have no more attempts to draw conclusions from experiments carried out in the face of more dependent variables than can be handled.

NOTES AND COMMENTS

"Atomic" Raw Materials

PROFESSOR M. L. OLIPHANT, of Birmingham University, whose remarks about atomic energy have embodied a good deal more common sense than those of most speakers, was extremely frank when he enlarged on the subject at a meeting of the Liberal Party Council in London on Wednesday last week. Declaring that there was no protection against the atomic bomb, he advocated the control of the essential raw materials as the most hopeful way of approaching the problem. There was no uranium in Britain, he pointed out, and precious little in the United States; in fact, America, from the point of view of raw materials, was unimportant. It was therefore not surprising that when the United States advocated the control of raw materials, other nations should be suspicious. As for the use of atomic energy for industrial purposes, he believed that Russia would solve the engineering and metallurgical problems involved sooner than Britain, and America sooner than either country. He was quite firm in averring that not only was there no protection from an atomic bomb which would probably be fired from a distance, but there was no cure for persons who had been affected by the resultant radiation. In our view, Dr. Oliphant is extremely sound in his refusal to shilly-shally over this problem. International control of some sort—preferably, it would appear, of the raw materials concerned—is the only reasonable method of dealing with the greatest potential danger that has ever threatened civilisation.

Uranium in France

REPORTS have been appearing intermittently in the French daily Press announcing the discovery of deposits of uranium ore in one or another part of France. It is a fact, says *L'Industrie Chimique* (1946, No. 349, p. 149) that certain secondary radioactive ores—formerly examined as possible sources of radium—have been re-examined to assess their uranium content, but no sensational discovery has been made. Actual radioactive mineral deposits of limited extent are widely distributed in the "Massif Central," the mountainous core of Central France, notably in the Morvan and the Monts du Forez. In the former locality a deposit near Autun has given name to the mineral autunite, a phospho-uranite of cal-

cium ($\text{CaO} \cdot 2\text{UO}_3 \cdot \text{P}_2\text{O}_5 \cdot 8\text{H}_2\text{O}$), while in other veins the presence of torbernite or chalcocite, a copper compound of similar nature ($\text{Cu} \cdot 2\text{UO}_3 \cdot \text{P}_2\text{O}_5 \cdot 12\text{H}_2\text{O}$) has been detected, and in certain instances, round about 1930, some of these deposits were actually worked for radium or uranium, the ore from one of the Morvan mines being despatched to the Baccarat glass-works. Recent prospecting has located other sources farther to the south and west. It is now believed, however, that these may merely be outcroppings of a subterranean mass of primary radioactive ores, of the character of pitchblende, hidden within the heart of the Massif Central; and it is suggested that the extraction of these is a problem worthy of the attention of French mining engineers. A search of the geological literature indicates that both of the secondary ores mentioned occur also in Saxony and Cornwall, while autunite has been reported from various places in the U.S., and torbernite from Czechoslovakia.

Advice on Research

THE appointment of a new chairman to the Advisory Council for Scientific and Industrial Research, as recorded in our "Personal Notes" seems an appropriate occasion for some reference to the functions of that august and influential body, especially since, in the 30 years since the D.S.I.R. was established there have been three chairmen only. Sir William McCormick, F.R.S., held the appointment from 1916 to 1930. He was neither a scientist nor an industrialist, but a Professor of Arts at a Scottish university, with a flair for administration and "getting things done." He was followed by Lord Rutherford of Nelson, F.R.S., the great scientist. On his death in 1937, Lord Riverdale of Sheffield, an iron and steel industrialist, became chairman and has held the appointment until now. The Advisory Council occupies a most important position in the organisation of the D.S.I.R. Its duties are to advise the Lord President of the Council on all research activities of the Department. The Council is composed of men who have an expert knowledge of science or of industry and labour. The members serve in a personal capacity and not as representatives of any organisation. Each member brings his own particular knowledge to the meetings of the Council so that every aspect of a problem can be

adequately studied. In consequence the composition of the Council is such that it makes an effective link between Government, Industry, and Science. It was probably the first example of a body of people, outside the Government, formed to advise on policy for implementation inside the Government. The main task of planning the post-war developments of the D.S.I.R. fell on the Council under Lord Riverdale. Most of the research Stations are being expanded and three new organisations have been or are being established. Increased financial support for the industrial co-operative research associations, for individual fundamental research workers, and for students have been made after careful inquiries. Special committees deal with grants to research associations, as well as to individuals, to assist them in fundamental research, and with maintenance allowances to students to enable them to be trained as research workers.

Britain Can Make It

AFTER taking a preliminary look round the exhibition which the King opened in the Victoria and Albert Museum, London, on Tuesday, we are left in no doubt that Britain *can* make it—and by “it” we mean almost the entire range of consumer goods. A whole year’s work has gone into the preparation of this exhibition and although, when the idea was first mooted, it was received with a certain amount of lukewarmness, for it was felt that the time was not ripe for such a large-scale affair, industry generally has given magnificent support, as is shown by the fact that the selected exhibits total not far short of 6000 and come from more than 1300 firms. Dominating everything is a sense of reaction from the severity and enforced simplicity of design in wartime. By this it is not implied that there is any tendency towards vulgarity or over-decoration, but there is plenty of evidence of a healthy regard for freshness and colour. While the exhibition is not a trade fair and is primarily intended to demonstrate the meaning of first-class standards in design, there is little doubt that its effect on the country’s export trade will be wholly beneficial. Not only is the exhibition admirably arranged, the goods themselves are presented in a manner that reflects nothing but credit on all concerned. The exhibition is certainly worth a visit, whether by consumer or producer.

The Importance of Quality

IN his opening speech, the King drew a parallel between this, the first post-war exhibition to be arranged and staged by one of the fighting nations, with that other pioneer exhibition, opened only a few hundred yards away by his great-grandfather, the Prince Consort, in 1851. Then, as now, one of the main objectives was the improvement of design. Indeed, the insistence on design has been the keynote of the publicity concerning the present venture, chief sponsor of which is the Council of Industrial Design. At the risk of being likened to Cassandra, we would here utter a faint note of warning. Design is a very important thing in itself, but it is not the whole story. Quality and workmanship are at least as vital. No one knows that better than the industrial chemist, who is usually more concerned with raw materials than with finished products; and no industry has suffered more in the past from the application of the wrong raw materials to otherwise excellent design than has the plastics industry. It was probably a mere coincidence that the B.B.C. chose Tuesday night to reconstruct and examine the Tay Bridge Disaster. So far as we know, the *design* of the old Tay Bridge has not been impugned; the disaster would appear to have been caused by dishonest workmanship and slovenly administration. So, however excellent a design may be, we must not forget to look beneath the surface.

MELDOLA MEDAL

The award of the Meldola Medal, which has been suspended since 1941, is to be resumed this year. The Society of Macchemans, in whose gift the medal is, will present the medal to the chemist who, being a British subject and under 30 years of age on December 31, 1946, shows the most promise, as indicated by published chemical work brought to the notice of the Council of the Royal Institute of Chemistry before December 31, 1946. No restrictions are placed on the kind of chemical work or the place in which it is conducted; and the merits of the work may be brought to the attention of the Council either by persons who desire to recommend the candidate or by the candidate himself. Letters of recommendation should be addressed to: The President, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1, the envelope being marked “Meldola Medal.” The award will be decided in January, 1947.

Wool Wax Alcohols

Their Properties and Utilisation in Industry

IN view of the increasing attention that is being paid to the industrial importance of wool wax, the appearance of a booklet* on the subject, collecting and correlating as much as possible of the published and unpublished literature on the subject, is most timely. In the following paragraphs, stress is laid particularly on some of the industrial applications of the component alcohols of wool wax, as indicated by Mr. Lower; the booklet itself contains full details from the chemical and technological, as well as from the industrial point of view.

The first plant for the continuous production of wool wax alcohols was laid down in this country in 1936. Previously the sources of supply had been Germany, America, and Holland, although the Dutch product, being a distillation material, was somewhat different in appearance from the others, and probably did not represent the alcohols as they are originally present in the raw material—wool grease.

The basic material from which these alcohols are prepared is either raw wool grease (acid-cracked or otherwise) or refined wool grease (wool wax, lanolin), a higher yield of alcohols resulting when the latter product is used. The grade of wool grease known as centrifuged neutral wool grease is also well known as a good source of the alcohols. This grease contains less free acidity than the "acid-cracked" wool greases, but slightly more than is contained in the refined product (lanolin). Raw wool grease is obtained from the sheep's wool by washing with alkalis, soaps, suint and/or newer detergents such as sulphonated alcohols. It contains combined and free alcohols, combined and naturally occurring free fatty acids, and also free fatty acids obtained from the wool washing liquors. Traces of sulphur, metals, moisture, and dirt are also present.

A True Wax

Neutral wool grease, or lanolin, is now established as a true wax, not a fat, and Lewkowitch actually proposed the term "wool wax" for this portion of wool grease many years ago, but the name did not seem to meet with a ready response in the trade at the time. It will be clear from this that the alcoholic constituents are, therefore, wax alcohols. Polyhydric alcohols are absent, although a dihydric alcohol, lanyl alcohol, has now been isolated. There is anything up to 7 per cent. of free alcohols in wool grease, especially the centrifuged

grades, with approximately 50 per cent. total alcoholic components (free and combined).

The actual and potential uses of this alcohol mixture seem to be enormous. It would appear to be a most promising material for production of fine chemicals such as cholesterol, "steroidal" hormones, vitamin-D precursors, etc., and at the same time is being widely used as an anti-corrosive coating composition in textile dressings, and ointment bases. These alcohols are the subject of a monograph in the Sixth Addendum (1943) to the B.P. 1932, under the title of "Wool Alcohols" (*Alcoholia Lanae*).

The question of the alcohols which are the actual components of the wool wax alcoholic complex yet remains to be answered in full, and a search of the literature shows the doubts and contradictory statements that exist on the subject. However, certain alcohols have been definitely isolated and identified, and these fall into three series: sterols, triterpene alcohols, and aliphatic alcohols.

Sterols

Only two true sterols have so far been certainly isolated from the mixed alcohols, these being cholesterol and cholestanol. Although it is known often to accompany naturally occurring cholesterol, there is nothing yet to indicate the presence in the wool wax alcohols of the chemical derivative of cholesterol, 7-dehydrocholesterol, the precursor of vitamin D₂. Up to 1937, the presence of minute quantities of ergosterol was regarded as not unlikely, though this too awaits confirmation, while the earlier belief that the so-called "metacholesterol," "oxycholesterol," and "isocholesterol" formed part of the complex does not find support in recent work.

Two cholesterol-rich fractions obtained from wool wax alcohols are now offered by Croda, Ltd., on the British market. The first, "Kathro" cholesterol, is a white amorphous powder, M.P. 110°C., (α_D) = -27.2° in chloroform, iodine value 53.5 per cent., cholesterol 70-72 per cent., agnosterol and lanosterol 2.5 per cent., optically inactive (aliphatic, etc.) alcohols about 25-30 per cent. This product is completely soluble in the following solvents at about 20°C., solutions being prepared by warming; amyl formate, cyclohexanol and its acetate, cyclohexanone, chloroform, dipentene, decahydronaphthalene, methyl abietate, octyl alcohol, oleic acid, rosin spirit, tetrahydronaphthalene, and xylol. It is substantially soluble in amyl alcohol and acetate, benzyl alcohol, carbon disulphide,

* *Wool Wax Alcohols in Industry*, by E. S. Lower, technical director of Croda, Ltd. Published by Croda, Ltd., Croda House, Snaith, Goole, Yorkshire.

carbon tetrachloride, cyclohexylamine, hexyl alcohol, methyl cyclohexanol, and light mineral oil. Its emulsifying power is equal to and even slightly better than that of pure cholesterol.

The other fraction, "Dastar" cholesterol, is an off-white to cream-coloured powder, (a) $D = -18.0^\circ$ in chloroform, iodine value 38.8, cholesterol 50 per cent., agnosterol and lanosterol about 5 per cent., optically inactive alcohols, etc., 45 per cent. This material has slightly better emulsifying ability than the former grade of cholesterol.

Applications of Cholesterol

Among industrial applications of cholesterol may be mentioned its use in the production of suspensions of titanium pigments, for instance, in thermoplastic materials such as are employed for paper impregnation to render these impermeable to liquids and gases, *e.g.*, waxes or resins. The function of the cholesterol in such a process is to aid wetting of the pigment by the waxes, etc., and for this purpose 0.01 to 1 per cent. is the quantity used. Cholesterol is mentioned as a suitable material for addition, in quantities up to 5 per cent., to condensation products of phenolformaldehyde with the purpose of eliminating high pressures and temperatures employed in the manufacture of these products; also the elimination of "pores" is claimed.

A process has been protected for incorporating irradiated cholesterol in soap, in an attempt to impart either anti-rachitic properties to the soap, or the beneficial dermatological properties that are possessed by or accompany, the anti-rachitic principle. The larger outlet, however, is the use of this sterol as a super-fattening agent. Various mixtures also have been suggested, consisting, for instance, of cholesterol and cholesteryl laurate and stearate, or the sterol and cetyl alcohol, or white wax. Cholesteryl esters may be useful in producing germicidal soaps, tending to increase the absorption of curative agents. Even small traces of cholesterol, it is maintained, enhance the cosmetic effect of toilet soaps. Cholesterol in an emulsified form easily penetrates the epidermis and imparts suppleness of the dermis. A specific example of a superfatting mixture consists of, approximately, cholesterol 5 per cent., lanolin 8 per cent., cetyl alcohol 14 per cent. An excess of cholesterol, incidentally, reduces the lathering power of soap to a greater extent than does lanolin.

Cholesterol-polyethylene glycol esters, obtained by reaction of cholesterol with ethylene oxide in an autoclave at about 120-140°C. have been protected, and products of this nature are described as having special properties of importance to the textile industry, particularly as dispersing agents for organic dyestuffs and basic dye-

stuffs. A process for rendering waterproof cellulose or cellulose derivatives containing wool or other textile materials employs, to this end, aliphatic isocyanates, and among the latter is mentioned cholesteryl-adipic acid ester isocyanate (in benzene). Wool muslin is treated with this solution, followed by removal of solvent and exposure to a temperature of 140°C. for two minutes. The textiles react superficially with the water repellents.

Substances for addition to cleansing, wetting out, foaming, dispersing, etc., baths in the textile and leather industries have been obtained in the form of sulphonated ethers or esters, of *e.g.*, cholesterol, and a polyhydric alcohol containing one or more mono-esterified acid radicals of boron or phosphorus. A recent American article suggests that the use of cholesterol materials in the textile industry over there is assuming importance. Among their uses are mentioned emulsion stabilisation and valuable lubricating, washing, dyeing and finishing properties. A proprietary article which has been made available is stated to consist of "especially treated cholesterol and sterols, far exceeding individual sterols in surface activity." The product is a semi-solid, non-volatile oil, completely soluble in most oils. Specific applications include its use for stabilising oil-in-water emulsions, and the ability to disperse, stabilise, solubilise, and promote even penetration of practically all types of dyes. The products have also been developed for stabilising printing pastes and emulsions, resulting in clear, sharp, uniform prints. It is conceivable that simple mixtures of cholesterol-rich fractions of wool wax alcohols and white mineral oils might react similarly.

The last reference to the uses of cholesterol deals with the manufacture of vitamin D_3 —the anti-rachitic vitamin—or the manufacture of the precursors of vitamin D_3 . Ordinary cholesterol, purified simply by re-crystallisation, may be anti-rachitically activated by exposure to the action of the cathode rays of a high-voltage cathode-ray tube. Cholesterol, or cholesterol-containing substances, are rendered pro-vitamin-containing by oxidation with non-gaseous oxidising agents of the type of hydrogen peroxide, benzoyl peroxide, eosin, and chromic anhydride. In another example, cholesterol is enriched in pro-vitamin D_3 by heating the sterol with solid benzoyl peroxide between 120° and 250°C.

Triterpene Alcohols

It is now known that the so-called "iso-cholesterol" fraction of wool wax alcohols is, in fact, a mixture of two unsaturated alcohols, lanosterol and agnosterol, classed as triterpene alcohols or resinols. They have thirty carbon atoms and a pene skeleton, consisting of five six-membered rings.

On dehydrogenation they yield picene and substituted naphthalenes.

This mixture of alcohols has been produced on a commercial scale from careful fractionation of the total unsaponifiable matter of wool grease, by distillation with the aid of superheated steam or other gas, giving 40 per cent. yield with products of oxidation. It has been obtained in the form of a pure white solid. It consists of 0.20 per cent. agnosterol plus 80-100 per cent. lanosterol, and is insoluble in methyl alcohol. As an emulsifying agent it has no special qualities, and has even been described as showing antipathy towards emulsifying, and insolubility in petroleum. Wool wax alcohols from which this binary mixture has been removed are said to have increased emulsifying properties.

It was soon observed that agnosterol was not always to be found as a constituent of wool wax alcohols, and, for this reason, attention was directed to the possibility of its formation by the action of the caustic alkalis used in preparing these mixed alcohols, on the major constituent of the "isocholesterol" mixture, lanosterol, but this was found not feasible. The name lanosterol was originally prepared to identify the "isocholesterol" product, being less misleading than the latter term; it was not then known that this product was a mixture.

Agnosterol

Agnosterol melts at 162°C. (α) $^{\text{D}}_{\text{D}} = +70.4^{\circ}$, crystallising in needles from ethyl alcohol. Its molecular weight is given as 424 ($\text{C}_{30}\text{H}_{48}\text{O}$). It differs from lanosterol in that it has one reactive double bond and two inactive double bonds. Two of these bonds are conjugated. An agnosteryl derivative, dehydroagnosteryl acetate, has been prepared from lanosterol and found to be identical with the same acetate prepared from agnosterol. This supports the knowledge that agnosterol and lanosterol differ only in the number and position of their double linkages.

Six years after the original isolation of agnosterol, similarities which exist between this chemical and theelin, the natural follicular hormone, suggested agnosterol as a starting material for the synthesis of artificial oestrogenic substances, and, in fact, such products were actually produced, of high oestrogenic activity, in the form of yellowish, glassy, jelly-like gums. The process used was one of oxidation by means of chromic oxide. The resultant active agents are not, however, identified. Untreated agnosterol possessed no activity when tested similarly.

Lanosterol forms the greater part of the methanol-insoluble matter of wool wax alcohols, has a melting point 140.5°C. (α) $^{\text{D}}_{\text{D}} = +57.9^{\circ}$ in chloroform. The molecular weight of this product is 426 ($\text{C}_{30}\text{H}_{48}\text{O}$). Its

iodine value is 170.5 by Dam's method. This has proved very reliable for sterols, bromine being used as the reactant.

Lanosterol is apparently very susceptible to oxidation (giving a mixture of ketones, if chromic anhydride is used) and shows a marked tendency to resinification. It does not give the strong colour reactions characteristic of sterols. It shows absorption of ultra-violet light. Upon dehydrogenation with palladium charcoal, it gives a hydrocarbon $\text{C}_{30}\text{H}_{46}$. It is soluble in chloroform, more difficultly soluble in ethyl alcohol, acetone, ligroin, and very sparingly in methyl alcohol. At the moment, there is no published information to indicate the possible uses of lanosterol, except in combination with agnosterol and epinephrine from the treatment of asthma.

Aliphatic Alcohols

Only two alcohols have been identified out of the mixture that is left after the sterols and triterpene alcohols have been separated out, which can be partly accomplished by solution of the whole in acetone, from which the bulk of optically inactive alcohols separate. These two are new alcohols and have not been found elsewhere than in wool wax alcohols. They are lano-octadecyl, a monohydric alcohol of mol. wt. 270 ($\text{C}_{18}\text{H}_{36}\text{O}$), m.p. $42-43^{\circ}\text{C.}$, and lanyl, a dihydric alcohol, mol. wt. 326 ($\text{C}_{22}\text{H}_{40}(\text{OH})_2$), m.p. 78.5°C. Although this alcohol seems to be unsaturated it does not absorb bromine at room temperature.

There are other alcohols to be identified and (of these the most important would appear to be cetyl alcohol, mol. wt. 242 ($\text{C}_{26}\text{H}_{54}\text{O}$), m.p. 49°C. , b.p. 190° at 15 mm., $\text{D}^{\text{D}}_{\text{D}} = 0.8105$, acetyl value 197. The remaining alcohols to which reference has been made in the literature seem, on recent work, to be themselves mixtures, their composition being still uncertain.

The uses of these types of alcohol are very well developed and include, of course, wetting agents, cosmetics, emulsifying agents, condensation products, lubricants, textile assistants, acetals, amides, esters, ethers, etc.

Mixed Wool Wax Alcohols

From the commercial point of view, really the most interesting product is the mixture of wool wax alcohols, offered by Croda, Ltd., usually in the form of small lumps or large blocks.

The alcohols are a yellow wax-like mixture, similar in many respects to beeswax, but more brittle. Warmed from, say, 5 to 65°C. , the mass moves through the stages of a pliable mass to a very viscous liquid, which takes many hours to reset to its original state. These alcohols do not decompose under normal storage conditions.

It has been shown that cholesterol, the main constituent, has an inhibitory action against the decomposition of oils and fats in which it is dissolved, and similar properties have been attributed to these mixed wool wax alcohols.

Upon standing undisturbed for any great length of time, say six months, the alcohols set to a very tough mass and assume a mirror-like brightness due, no doubt, to surface oxidation and resinification. The depth of this resinified layer has been found not to exceed 1/16th of an inch after the storage over a period of four years. The free fatty acid content of the layer after this period had risen from 0.69 per cent. to 17 per cent. Means have been found of accelerating this modification with the object of using such derivatives as coating compositions. The mixture will not polish, but it breaks with a clean fracture.

General Composition

A general compositional analysis is as follows: cholesterol, 25.5 to 33.1 per cent., cholestanol (and other saturated sterols) 2.5 to 5.1 per cent.; agnosterol, 0 to 5.3 per cent., lanosterol 21.3 to 26.6 per cent.; optically inactive (aliphatic) alcohols, etc., 50.7 to 29.9 per cent.

In Table 1, an average analysis of "Hartolan" wool wax alcohols is given in column (1); the other two sets representing figures published for an American (2) and German (3) product are included for comparison purposes.

It will be seen that this mixture of alcoholic bodies differs in many ways from true waxes and wax-like materials on the market. Probably the most interesting feature, apart from the low acidity and saponifiable content, is the high, or comparatively high, melting point, taking for comparison spermaceti, cetyl alcohol, stearic acid, and some synthetic and mineral waxes.

TABLE I.

	(1)	(2)	(3)
Ash content ...	0.25%	0.02%	—
Acid value ...	1.8	2	1.5
Acetyl value ...	130	109	—
Cholesterol ...	32%	16.5%	—
Ester value ...	2.0	—	—
Iodine value (Wijs) ...	45.5	77	—
Melting point ...	60.5	57	57
Mean molecular weight ...	377	—	—
pH value ...	5.7	—	—
Specific optical rotation (α) _D ...	-11.8°	-0.6°	—
Saponification value ...	8	62	23
Unsaponifiable matter ...	97%	80%	—
Viscosity at 200° F. (Redwood No. 1) ...	216 sec.	—	—
Water-soluble matter ...	<1%	—	—

The solubility of wool wax alcohols in various solvents is reflected in the following observations on solutions (20 per cent. w/v), prepared hot and put on one side for a week at about 20 °C. using Hartolan wool wax alcohols:

(1) Complete solubility: carbon bisulphide and tetrachloride, chloroform, methyl

cyclohexanol, rosin spirit, trichlorethylene, toluol.

(2) Very slight deposit found: amyl alcohol, benzol, cyclohexanol, decahydronaphthalene, dipentene, ethylene glycol mono-butyl ether, methylene dichloride, solvent naphtha, tetrahydronaphthalene, white spirit.

(3) Substantially insoluble: acetone, butyl alcohol, acetate, formate, lactate, and phthalate, acetal solvent, cyclohexanone, cyclohexanol acetate, diacetone alcohol, dibutyl phthalate, diethylene glycol mono-ethyl ether, ethyl ether, ethyl phthalate, ethyl acetate, ethyl lactate, ethylene glycol, mono-methyl ether and acetate, isopropyl alcohol and acetate, isobutyl alcohol, methyl ethyl ketone, methyl alcohol and acetate, petroleum ether.

One of the most important properties of wool wax alcohols is their power to emulsify and hold large quantities of water, forming emulsions of the water-in-oil type. Also, they can be diluted with oils, fats and even some solvents, for example, liquid paraffin, white oils, white spirit, or liquid fatty alcohols (oleyl) and the resultant mixtures and solutions used as emulsion bases, producing in turn water-in-oil emulsions when agitated with water. The use of kerosene for this purpose (in conjunction with lanolin) is the subject of a recent British patent, covering the product now sold under the trade name Furmantum emulsifier.

Wool wax alcohols water-in-oil emulsions, when well prepared, are very stable in the presence of electrolytes, mild acids, metallic salts, etc., and do not go rancid.

Main Groups of Uses

The many uses of these alcohols can be divided into two main groups. The first contains the many applications of the alcohols as purchased, and without further treatment, e.g., as true wax substitutes, or emulsifying agents, plasticisers, etc., while the second group contains the uses of the alcohols when treated to give valuable reaction products, e.g., wetting agents or sterol derivatives. The majority of the subject matter is protected by patents or patent applications, and this publication cannot be held to give protection against action for infringement.

In one patented process, for the manufacture of concentrated aqueous dispersions of "waxes and rosin," the procedure consists of heating together a mixture of wax and rosin (19:1) in the presence of water, plus a calculated amount of alkali. This emulsion is of the oil-in-water type and is used for paper sizing, etc. Another oil-in-water emulsion of similar make-up, used for lubricants, polishes, waterproof paper, etc., consists of an emulsified mixture of neutral waxes and hydrocarbons of high melting-point, with one or more alcohols, including

wool wax alcohols, plus fatty or resin acids. A 2 per cent. sodium carbonate solution is used as the dispensing medium and up to six times the weight of the fatty bodies may be used.

Another process, for producing aqueous bituminous emulsions, employs 5 per cent. wool wax alcohols. Molten or liquid bituminous material and the alcohols were mixed together and hot water added. Another example employed wool wax alcohols and a fatty acid, plus alkali, prior to addition of the water.

It has been found that the properties and combustion of motor fluids, such as benzol, alcohol, crude oils, etc., are improved by the addition of wool wax alcohols. For example, pinking or knocking may be eliminated or reduced. For this process, wool wax alcohols of a bright yellow colour are to be preferred, since this is said to indicate the presence of unaltered colouring matter, lanaurin, probably related to bilirubin, which, in combination with the mixed sterol alcohols, appears to be of advantage in reducing the rate of fuel combustion. The preferred mixtures include petrol, 1 gal. plus 0.5 to 2.0 g. wool wax alcohols.

In a pigmented form or mixed with resins, other wax-like materials, pigments and solvents, these materials have been found to give ideal pastes for use between dissimilar metal jointings, to prevent electrolytic corrosion. Such mixtures also have been employed as jointing pastes for filling screw head holes in wood, etc., rust holes in metals, and as putty substitutes. Another important use is the fixing of lenses into optical or other lensed instruments, and their parts. Black pigments are most suitable for this last purpose.

Fat-Liquoring Tests

Experiments on the use of wool wax alcohols for fat-liquoring have been carried out, and, from a few preliminary tests, it was found that both saponifiable and mineral oils could be readily emulsified by the aid of these alcohols in the presence of a small quantity of soap. A convenient method for preparing the emulsions which could be used in ordinary tannery routine is as follows: Dissolve the wool wax alcohols in the oil to be saponified by gently warming together. Dissolve the soap in a convenient amount of warm water, and then pour the oil mixture into the soap solution. Moderate agitation produces a stable emulsion which can be further diluted if necessary.

The next step was to ascertain the relative proportions of the constituents to use, bearing in mind that in most tanneries the water used for fat-liquoring, although the minimum in volume, will usually contain some hardness. Five per cent. of wool wax alcohols on the weight of oil being emulsified was adopted as a suitable proportion.

A composition containing "Hartolan" wool wax alcohols has been prepared for investigations concerned with the determination of the effect of perspiration on shoe materials, and consists of 0.5 litres of the following solution:

Urea crystals	...	...	1 gram.
Lactic acid B.P.	...	...	5 ml.
10% aq. disodium phosphate	...	...	1 ml.
N. sodium chloride sol.	...	...	100 ml.
Distilled water added	...	...	500 ml.

gradually added to a molten mixture of:

"Hartolan" wool wax alcohols	...	...	20 g.
Butyric acid	...	...	5 ml.
Saturated alcoholic egg lecithin	...	...	10 ml.
Russian tallow	...	...	1 ml.

at 35° C., using a powerful whisk.

(To be continued)

German Technical Reports

Latest Publications

SOME of the latest technical reports from the Intelligence Committees in Germany are detailed below. Copies are obtainable from H.M. Stationery Office at the prices stated.

CIOS XXXII—124. *Items selected from the minutes of meetings of the I.G. Technische Ausschuss:* New acetylene chemistry; Zinc amalgam electrolytic process; Mersol as a fat-substitute product; Polyurethane; New developments of di-isocyanate chemistry; New things in acetylene and carbon monoxide chemistry (1s.).

BIOS 171. *Dr. Alexander Wacker Ges. für Elektrochemische Industrie, Burghausen:* Catalytic hydrogenation of acetylene to ethylene. (1s.)

BIOS 496. *Extraction of copper and other metals from pyrites cinder* (2s. 6d.).

BIOS 594. *The production and application in Germany of high-silicon acid-resisting iron* (3s. 6d.).

BIOS 676. *German metallurgical laboratories for ferrous metals, with special reference to the K.W. Institute for Iron Research* (8s. 6d.).

BIOS 688. *Interview with Dr. Stecklin and Dr. Koolig, formerly of the Leverkusen Laboratories of I.G. Farben A.G.:* Merits of synthetic and natural rubbers and the compounding and processing of synthetic rubbers in tyre manufacture (6d.).

FIAT 213. *Summary of field investigations:* Fats, oils and oilseeds (2s. 6d.).

FIAT 364. *German fats, oils, and oilseed processing plants* (2s.).

FIAT 535. *Industrial X-ray field in Germany* (1s. 6d.).

FIAT 681. *The paint, varnish, and lacquer industry of Germany* (5s. 6d.).

"Britain Can Make It"

Exhibition Opened this Week

HM. THE KING, accompanied by the Queen, opened the "Britain Can Make It" exhibition in the Victoria and Albert Museum, London, on Tuesday. The exhibition will remain open until a date between October 31 and November 23, according to attendance. As noted elsewhere in our columns, a request has been received from Scotland for the exhibition to be transferred there later.

Organised by the Council of Industrial Design, the exhibition covers almost the entire range of consumer goods and is selective, more than 5000 articles having been chosen by about twenty selection committees from a total of about 20,000 submissions. The exhibits demonstrate strikingly the rapid change-over from war to peace production in Great Britain, and show a new high level in design standards. The exhibition is not a trade fair, but there are numerous information kiosks at which home and overseas buyers may obtain particulars of goods in which they are interested.

Although there are no chemical exhibits as such, manufacturers and others in the industry will doubtless be interested in the plastics section of the materials group. This presents many of the latest applications of plastics, among the firms co-operating being I.C.I., Ltd.; Bakelite, Ltd.; De La Rue Plastics, Ltd.; BX Plastics, Ltd.; Holplast, Ltd.; Thermo-Plastics, Ltd.; Tenaplas, Ltd.; Catalin, Ltd.; and Moulded Components (Jablo), Ltd.

Chemical Exports

Drop in Figures for August

AUGUST exports from the U.K. totalled £14.5 million less than the July record of £91.9 millions, mainly due to the general holiday, but in part to the steel shortage.

The Board of Trade monthly accounts for August show that exports of chemicals, drugs, dyes, and colours were valued at £5,827,448, which is £643,905 less than the July total, but £2,531,646 more than the figure for August last year and £3,970,799 above the monthly average for 1938. British India led the buyers with purchases totalling £932,608, followed by Australia (£387,199), and the Union of South Africa (£272,714). The quantity of finished dyestuffs (930 tons) was the highest on record and twice the monthly average of the best pre-war year.

Imports of chemicals, drugs, dyes, and colours into the U.K. during August showed an increase for the first time for several months. The total value is given as £1,536,852, which is £183,662 above the July figure; £340,624 above the figure for August

last year; and £402,462 more than the monthly average for 1938. The U.S.A. was the largest supplier during August, with goods valued at £434,504; the Argentine Republic was second (£170,260); and Palestine third (£153,928).

German Casein Plastics

Little Progress in War-Time

DIAGRAMS and illustrations of the most up-to-date machinery used in the German casein plastics industry are included in BIOS Final Report No. 282, together with translations of certain German patents on the subject. As noted in Mr. Dutton's article on p. 383, little progress appears to have been made by this industry in the past 15 years and, so far as the war period is concerned, manufacture of casein plastic articles practically ceased, due to a shortage of rennet casein. An exception was the International Galalith Co., who continued manufacture on a reduced scale until 1944.

This company uses an interesting extruder with a special nozzle, of which drawings are given in the report. Various configurations are described, including basket work pattern, star pattern, spot pattern, etc. To produce the star pattern, star configured rods are extruded through a special nozzle and then packed in a standard block press box, in layers, in such a way that the rods are not bent and that each successive layer rests in the grooves of the preceding one. The mass of rods is then pressed cold, sufficient heat being preserved in the extruded rods to consolidate the casein. After removal from the press and cooling, the mass is placed on edge and after glueing to a base, is sliced into sheets.

The International Galalith Co. has three special machines which are used for grinding flat and round rods so that hexagonal, heptagonal and similarly shaped rods can be produced, suitable for the pen, pencil and allied trades. The speed of the wheels of these machines is 4500 r.p.m.

Drawings of an apparatus manufactured by Hermann Berstorff, Hannover, illustrate a special mixing nozzle developed for the International Galalith Co. No perforated plate is used in this design, the plastic being thoroughly homogenised by churning between a revolving toothed wheel plate and stationary wheel.

Mention is made of two processes designed to produce transparent effects. At one factory diphenylamine is the reagent used and at another a mixture of two parts of ethyl benzyl aniline to one part of dichlorhydrin is employed. A note is also given on an interesting development in the production of embossed sheet at the August Ehhardt Sohn Works at Dürach.

French Chemical Notes

Bigger Output of Fertilisers

DURING the war, numerous French plants producing fertilisers and agricultural chemical products were destroyed or seriously damaged, while many warehouses similarly disappeared from economic life. Before 1939, annual output of nitrogenous fertilisers in France absorbed 180,000 tons of nitrogen, or 15,000 tons a month, representing a tonnage of fertilisers of from four to five times this figure.

In August, 1944, output amounted to 3500 tons of nitrogen a month; in April, 1945, to 5000 tons; and in June, 1946, to 14,000 tons. Current output is said to equal the pre-war figure, and should soon exceed it. This recovery is due not only to the activities of the directors and workers of the plants concerned, but also to the progressive increase in supplies of coal, coke, wagons, and ferrous metals. If imports from the United States, Chile, and Norway are added, French agriculture has thus had between 100,000 and 110,000 tons of nitrogen at its disposal for the season ended June, 1946. It is hoped that this figure will be increased to about 225,000 tons for the season ending June, 1947.

Cut off from North African phosphates, French producers of superphosphate had to suspend output completely as from the end of 1942, but with the resumption of imports from the colonies recovery has been rapid. In 1938, output reached 1,200,000 tons. After some two years of inactivity, output was resumed in January, 1945, increasing rapidly from 177 tons in January to 3600 tons in April, 11,000 tons in July, 48,000 tons in October, and 54,000 tons in December. This steady increase has continued, and output last June reached 100,000 tons. From July, 1945, to June, 1946, total production amounted to 726,000 tons of superphosphates, of which 510,000 tons were distributed before the end of June. Output during the current season should again reach the pre-war level.

Potash

Output of potash has also increased rapidly, from 10,000 tons in June, 1945, to 50,000 tons in June, 1946. A total of 218,000 tons of potash was distributed during the season, compared with some 300,000 tons in an average pre-war season.

Among agricultural chemicals, 90,000 tons of sulphur were distributed in 1945-6, against an annual pre-war consumption of about 75,000 tons, while output of copper sulphate, the war-time shortage of which—real or imaginary—was the excuse for the requisition of copper articles from households and communal properties, is also

satisfactory. Home production and imports supplied 100,000 tons during the 1945-6 season, against a consumption in 1938 of 80,000 tons.

Progress in output in the last eighteen months has been significant, production rising from only 75 tons in January, 1945, to 2132 tons in April, 4898 tons in July, and 8900 tons in May, 1946. Satisfactory as these figures may be, however, the demand for fertilisers is likely to remain high for some years to come, owing to the impoverishment of the soil through five years of under-fertilising and exhaustion.

Pharmaceuticals

The immediate post-war crisis in the French pharmaceutical industry seems to be at an end, for 1945 output was almost up to pre-war figures, while current output exceeds that of 1938 by from 30 to 40 per cent., and exports of drugs are now being resumed on an increasing scale. Accumulated demands on the part of consumers and the necessity for the reconstitution of stocks are, however, still hindering the return of normality to the market.

The position of the laboratories is much easier with regard to mineral and colloidal products, but supplies of silver nitrate, zinc oxide, and tartaric acid are still restricted. The situation of the most important alkaloids—digitalin, opium alkaloids, etc.—is satisfactory, but difficulties still remain in the supply of strychnine and spartoin. Supplies of caffeine, theobromine, theophyllin, and cocaine are almost normal, but atropine and pilocarpine are still affected by import difficulties. Recent arrivals of cinchona bark have permitted the resumption of quinine production.

Output of penicillin has now been started on an industrial scale, and by the end of the year some 50,000 million units a month will be at the disposal of the Department of Public Health.

A State-controlled organisation, the Société des Produits Biochimiques, is now being formed to undertake production of penicillin and other modern antibiotic medicines. The increase in the price of pharmaceutical products (about 200 per cent., as compared with 1939) is helping the recovery of an industry on which France is placing great stress for the development of her export trade.

Austria has started prospecting for oil in the southern province of Burgenland. Lignite deposits have been discovered at St. Michael, extending as far as Güssing.

The Chemical Society

More London Meetings

THE London programme of meetings of the Chemical Society for the forthcoming session shows a return to the pre-war practice of having fortnightly meetings at Burlington House on the first and third Thursdays of each month. The time of meeting is to be 7.30 p.m. during 1946 and if this time proves to be acceptable to Fellows it will probably be continued into 1947.

Perhaps the most outstanding item in the programme is the Liversidge Lecture on "Some Problems in the Separation of Isotopes," which is to be delivered by Professor Harold C. Urey, Nobel Prizeman, of U.S.A., on December 18. Professor Maurice Stacey and a discussion of "Electrolytic Solutions" Tilden lectures entitled respectively, "Macromolecules Synthesised by Micro-organisms" (December 5), and "The Application of Surface Chemistry to Colloidal Problems" (February 6). On November 7, Dr. G. M. Bennett, Government Chemist, is organising a discussion on "Nitration," and a discussion of "Electrolytic Solutions" is to be arranged for April 17. The reading of original papers, to which seven or eight meetings are to be devoted, constitutes an important aspect of the Society's work, and at the first meeting of the session on October 2, papers by Professor C. N. Hinshelwood, president, on "The redistribution and desorption of adsorbed gases," and by Professor J. Monteath Robertson on "The crystal structure of pyrene," will be read and discussed.

Research Fund

Chemical Society Grants

A MEETING of the Research Fund Committee of the Chemical Society will be held in November. All persons who have received grants, and whose accounts have not been declared closed by the Council, are reminded that reports must be received by the Society not later than November 1.

Applications for grants, to be made on forms obtainable from the General Secretary, the Chemical Society, Burlington House, Piccadilly, London, W.1, must be received on or before November 1. Applications from Fellows will receive prior consideration.

Attention is drawn to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is principally devoted to the encouragement of research in inorganic and metallurgical chemistry, and that the income from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal tar and allied industries.

Science and Public Welfare

Forthcoming Conference

A CONFERENCE under the title of "Science and the Public Welfare" will be held at the City Memorial Hall, Sheffield, on the afternoons of November 16 and 17. The purpose is to give people of the northern counties some insight into the part science is playing in the interests of their general welfare.

Internationally known scientists will address the conference and most aspects of scientific work will be represented. Professor P. M. S. Blackett, F.R.S., of Manchester University, and Professor J. D. Bernal, F.R.S., of London University, will speak on the social implications of science. Dr. J. Rotblat, Director of Atomic Research at Liverpool University, is to address the conference on "The Future Use of Atomic Energy." There will also be speakers from the public health services, and Captain T. W. Barnard, of the Radiotherapy Centre, will speak on the work of that institution. Medical scientists will give some indication of progress in medicine and surgery. It is hoped that a representative of the Government will give an address at one of the sessions, and it is expected that several foreign scientists will take part.

The conference is being organised by the north-east area committee of the Association of Scientific Workers, 25 Change Alley, Sheffield, 1.

SILICONES

Albright & Wilson, Ltd., have been appointed distributors of silicone resins, fluids, greases, Silastic rubber, and other Silicone materials manufactured by the Dow Corning Corporation of Midland, Michigan. These interesting new chemicals have a variety of uses in electrical insulation, lubrication, paints, instrument, and hydraulic fluids, jointing material, etc. A supply of Silicones will shortly be available in this country. Inquiries for literature and samples should be sent to Albright & Wilson, Ltd., 49 Park Lane, London, W.1 (Tel.: GROsvenor 1311).

"Chemicals for Every Industry" is the claim of Monsanto Chemicals, Ltd., Victoria Station House, Victoria Street, London, S.W.1, who have just produced a concise list of Monsanto products. In handy form, this publication contains an alphabetical list of products, with general information concerning each, in abridged form. It is pointed out that the skilled and experienced advice of the Monsanto Technical Service is available if desired.

Vinyl Resins*

Compounding and Fabrication in the U.S. To-day

THE origin of vinyl plastics dates back to 1838, when a white powder was produced by exposing vinyl chloride to sunlight. In 1872 other vinyl materials were discovered which were unaffected by solvents or acids, and rubber-like vinyl compounds were obtained in 1912. But it was not until 1927, when industry was seeking new and improved materials, that the intensive research of Carbide and Carbon Chemicals Corp. developed the first commercially successful vinyl resins. They were turned over to National Carbon Co., another member of the Union Carbide and Carbon Corp. family, to pioneer on a pilot plant scale; and when Bakelite Corp. came into the fold, all compounding of resins within the Union Carbide family naturally became that subsidiary's responsibility.

Plans were made in 1940 for a large plant at Bound Brook, N.J., where Bakelite's greatest production activities already were centred. This plant was completed in 1941, just in time to be of inestimable value to the U.S. services during the entire period of the war, since they filled a place which many of the other older resins could not, and did it extremely well.

Here the synthetic resins in the form of white powders, produced at the South Charleston, W.Va., plant of Carbide and Carbon Chemicals Corp., are compounded and fabricated. This consists of mixing the resins with the proper lubricants, stabilisers, opacifiers, and colouring materials, then, fluxing and milling. The resin "doughs" are next sheeted and ground, extruded, or calendered on paper, cloth or without backing material, depending upon the form to be produced. The fluxing, milling and sheeting operations are accomplished with heated mixers and roll mills in much the same manner as rubber compounding.

Raw Materials

The principal raw materials for the Bound Brook plant consist of several types of vinyl resins, polyvinyl butyral, and copolymer of vinyl chloride and vinyl acetate. Four varieties of the copolymer are used in which the ratio of vinyl chloride to vinyl acetate covers a range from 86:14 to 95:5. In general, those resins containing large amounts of the chloride are used in flexible types of products and conversely those resins low in chloride are the basis for the rigid products.

The next most important group of raw materials from the standpoint of volume is the plasticisers. To some extent, they, too,

are made at the South Charleston plant. For general-purpose plastic compounds diethylhexyl phthalate and tricresyl phosphate are used. For plasticising polyvinyl butyral resin triethylene glycol di-2-ethylbutyrate is required. Copolymer resins containing higher ratios of vinyl acetate do not require the addition of plasticising agents to form rigid shapes. This probably accounts, in part, for the desirable aging characteristics exhibited by rigid materials.

Other raw materials, heat stabilisers, colorantes, fillers, and lubricants come from other suppliers. Heat stabilisers inhibit decomposition of the vinyl chloride. They are lead soaps, litharge and white lead. For colouring materials, lakes and pigments are preferred because of better light stability than dyes. The fillers consist of finely divided clay, calcium carbonates and other materials. The principal lubricants are metal soaps and fatty acids.

Raw materials are shipped to the plant by rail or truck. Resins arrive in multiply paper bags or in special hopper bottom boxcars, while plasticisers reach the plant in tank cars, and the other components in drums, barrels and bags. The plasticisers are stored in steel tanks outside the building. The other materials are stored in the raw materials storage space running the entire length of the building on the south side.

Handling the Resin

In the centre of this long room are two pneumatic air systems for handling the resin raw material. Bags of resin are emptied into the system's hopper and the resin is then passed through a vibrating screen located in a horizontal tank under pressure to prevent dust. Here any metallic particles or casual contamination which may have been picked up during transport of the resin will be removed. The resin is then transferred by air pressure through a 4-in. line to the top floor. Here the resin is stored in any one or more of the 28 aluminium storage bins of 35,000 to 40,000 lb. capacity each, arranged in two rows along the north and south sides of the building. The powdered resin is separated by cyclones above the bins and the air returned through bag houses and exhausted to the atmosphere.

Dry components, fillers, dry lubricants and some colours are carried to the floor below that on which the resins are stored by means of freight elevators. They are stored in hoppers equipped with dust collectors. A batch of the dry components, other than resin, is made in a weigh lorry placed beneath the hoppers. Lorry and contents are then

* Chem. Eng., 1946, 53, 120.

moved along the overhead tram-rail to a blender underneath a resin storage bin. Below the storage bins are stainless-clad steel blenders of 5000-lb. capacity. Each blender is jacketed and equipped with a horizontal ribbon agitator, which is designed to draw the mixed material to the opening in the centre of the bottom for discharging.

The batch of dry components is transferred into the blender and the resin added. Approximate weights are checked automatically and final adjustments are manual. A photo-electric device on the scale shuts off the addition of material when the predetermined weight has been reached. Plasticisers are added to the charge in the blender through metering pumps and a pipe-line running the length of the blender on one side and near the top. By spraying the liquid plasticiser over the mass the best mixing results are obtained.

Blending Process

Certain of the lubricants are too viscous at room temperature for proper blending with the resins and other components of the batch. To overcome this factor, such lubricants are heated to the point at which they are sufficiently fluid in nature to allow adequate mixing. This blending system was installed so as to improve the quality of product and to increase output from the equipment.

The blended compound in the form of a powder moistened with the plasticiser is dropped into a stainless-clad steel weigh lorry directly below the blender. The mass is held in the lorry until the mixer is empty and ready for another change. A lorry operates on an overhead tram-rail and serves two blenders. It is moved to a point above the opening in the floor through which the contents can enter a mixer.

In most cases the pigments are added to the mass in the mixer. It is not necessary to add them to the resin mass at an earlier step in the processing, and if the pigments were so added, particularly the intense ones, they would make it difficult to clean the equipment. When long runs are made, the pigments are added in the blender. The pigment used determines the method employed to disperse the pigments in the plastic compound. In some cases a 3-roll paint mill is used to grind the pigments into the plasticiser to form a paste. An intensive type of mixer is used to disperse the paste pigments with resin and is generally used when the mix is wet or damp. Dry resin-pigment mixes are blended in an end-over-end dry blender. The resultant mix is added to the mixer as a colour composite.

A system of signal lights provides communication between the mixer operator and the operator of the charging lorry on the floor above. Each mixer has a capacity of about 150 lb. of material. The mass is mixed

until it reaches a predetermined temperature on the indicator. This requires from two to eight minutes, depending on the formulation. The mixer fluxes the mass by frictional or applied heat and changes the dry, bulky material into a coherent dough.

The mixer dumps the mass on to a conveyor which carries it on to a hot 2-roll mill. After further mixing on this mill it is removed by hand and placed on an elevating conveyor, which carries it to the top of a 4-roll 3-high calender. Rolls are 66 in. wide and steam heated. To govern thickness of the product, a motor is provided to move the rolls together or apart, as the case may be. The motor requires one minute to move the rolls 0.0025 in. apart. Flexible material can be calendered into tape, thin film, heavy sheeting or material to be granulated. Rigid compounds are generally calendered into sheet form.

The reason for having a number of bays and for separating them by partitions is to segregate the operations and raw materials, especially colours and resins, leading to different types of end products. In each of the bays material for a different purpose may be produced. In one bay film of 0.004 in. thick was leaving the calender. It is for use in making consumer goods, such as rain-coats, shower curtains, umbrellas, etc. In another bay the calendered film is moved directly by overhead conveyor to a granulator. After granulation it is pneumatically conveyed into a cyclone and discharged on to a magnetic separator and vibrating screen. The material is then bagged for shipment. This granulated plastic is for electrical insulating and moulding compounds. Most of the bays contain two mixers. The two are required to supply the mill and calender when thick sheeting is produced.

Plastic Sandwiches

In yet another bay transparent, translucent, or opaque sheeting from 1/10,000 in. or upwards, with a matt or polished surface, is made from calendered sheeting in a hydraulic press with heated platens. The press has ten openings. Sheets of plastic are built up into sandwiches consisting of a number (depending on the thickness to be planished) of metal planishing plates and sheets of plastic, then loaded into ten openings of a 20-opening hydraulic elevator. Alternate openings are vacant. Sandwiches are transferred to empty openings in the elevator. The elevator is dropped one opening and the sandwiches to be pressed are inserted in the open press. The pressing cycle is automatic and is controlled by recording and controlling equipment. When the sheets are removed from the pressing operation they are carefully inspected under fluorescent light for imperfections and packed into paper-lined wooden boxes. To

protect the finish on the surfaces of the polished sheets and metal plates, the operators wear gloves.

Boxes of plastic sheets are handled on ball-type conveyor tables. This type of conveyor is convenient for handling boxes where there are corners to be turned and for turning the boxes around and otherwise handling them. The conveyor was constructed in Bakelite's own machine shop from ball and socket units obtained from conveying equipment companies. The steel balls are 1.5 in. in diameter and each socket unit is rated at 100-lb. load carrying capacity.

Vinyl resin coated paper to be made into linings for food product packages is produced in another bay. Vinyl resin compound plasticised with an innocuous material is calendered on to bleached sulphite paper for this purpose. A magnetic gauge continuously measures the thickness of the coating on the paper. The resin compound for the lining material is white, soft and flexible. It will not be attacked by foodstuffs and most chemicals. The resin coating and paper are of approximately equal thickness and total 0.005 in.

Safety Glass

The sandwich material for safety glass is based on polyvinyl butyral resin. The demand for safety glass is so large in normal times that the equipment in one bay is kept continually busy on this one application. The resin is plasticised with triethylene glycol di-2-ethylbutyrate. The materials are then mixed. The mass is calendered and dusted with sodium bicarbonate, which reduces the tackiness. On leaving the calender the film passes through a festoon dryer (where the water is removed) and then rolled into continuous lengths. The speed of the festoon passing through the dryer is co-ordinated with the calendering rate by two photoelectric devices.

The railway siding along the south side of the building in which the vinyl resin compounds are produced is reserved for incoming raw materials and the siding along the north side for outgoing finished products. Raw materials are stored in the space that extends the entire length of the building on the south side. Finished plastics are stored in the corresponding space along the north side. In between these two large rooms and perpendicular to them are 16 operating bays. This arrangement provides straight-line flow of materials.

The general lay-out of the building is such that extensions can be added without disrupting the present plan concerning facilities and flow of materials. The significant feature of the construction is the fact that all manufacturing areas are windowless, with artificial lighting and air conditioning for purposes of cleanliness, working comfort of personnel, and maintenance of uniform pro-

cessing temperature. These features are very important from the standpoint of product quality. Every possible precaution is taken to prevent contamination of the materials during storage and processing in order to turn out a product of the highest purity and perfection. Much of the processing equipment has been made of special alloys to prevent any corrosion or even tarnishing with resultant discoloration of product. The resin storage bins are aluminium, and the blenders, lorries and hoppers are made of stainless-clad steel. All machinery has been painted white to encourage cleanliness. The operators are required to wear white work clothes. The men and women in the laminating bay wear white gloves. Dust arresters are used on several operations to help yet further in the manufacture of high quality products.

When the fabricating plant was completed in 1941, the air conditioning system was one of the largest industrial installations at that time. An interesting sidelight in connection with this great plant and its large air conditioning system is the rôle that the late Dr. Leo Baekeland, founder of the Bakelite Corp., played in the field of air conditioning. Dr. Baekeland is said to have been the father of modern industrial air conditioning (paper read before the International Congress of Applied Chemistry in Berlin, 1903).

This air conditioning system consists of two compressors, each with a capacity of 500 tons per 24 hours of refrigeration. Only one is used regularly during the summer months; the second is used for stand-by service and for possible additions to the buildings.

The volume of air circulated in each of the 16 manufacturing bays is 45,000 cu. ft. per min. All the air is filtered and half of it is conditioned to 85° F. and 40 per cent. relative humidity, to be circulated in the working area. The balance of the air is filtered raw air and is circulated inside the machine enclosures. The positive air pressure maintained in each bay, for the purpose of excluding airborne dust, is a fraction of one inch hydrostatic water pressure.

George Kent, Ltd., Luton, who employ 2000 people in the manufacture of meters and industrial instruments, have hit upon an admirable method of making known their principal standard productions, without infringing current paper restrictions, by producing a miniature catalogue, the first of the post-war editions. The catalogue loses none of its usefulness by reason of its reduced size, but acts as a quick reference guide to a wide range of products which have gained a high reputation. Publications giving full details are available for each product, and their reference numbers are given in the miniature catalogue, which is very well illustrated.

LETTER TO THE EDITOR

Compound "1553"

SIR.—In your issue of August 31, p. 257, reference is made by your Cape Town Correspondent to "1553" and it is stated that this preparation was being obtained from America. This is not correct: "1553" is a purely British development.

The compound, 2:7-diamino-9-phenyl-10-methylphenanthridinium bromide, was first synthesised at the Chemical Research Laboratory, Teddington, by Dr. L. P. Walls. It is, in fact, compound number 1553 in the C.R.L. series. It was found to be active against *Tryp. congolense* by Professor C. H. Browning, F.R.S., of Glasgow University. Tests in Africa proved its efficacy against nagana. The drug is being manufactured by Burroughs, Wellcome & Co. and May & Baker, Ltd.—Yours faithfully,

R. P. LINSTED,
Director.

Chemical Research Laboratory,
D.S.I.R.

Teddington, Middlesex. September 17.

Streptomycin

Production Planned in Great Britain

THE CHEMICAL AGE was informed this week that pilot-scale production of streptomycin is to be undertaken by a number of British firms, with the co-operation of the Ministry of Supply, Ministry of Health, and the Medical Research Council. It is hoped that preliminary clinical trials will begin before the end of the year. The firms at present concerned are Boots, Glaxo Laboratories, and the Distillers Company, who are all established penicillin manufacturers, and the Heyden Chemical Company, who propose to instal a factory to produce penicillin and streptomycin at Ardrossan, Scotland.

Streptomycin will not be released for use by the general medical profession until the clinical conditions which respond to it have been clearly established. The clinical trials of necessity will be prolonged; in the meantime, plans for large-scale production, to meet the demands of the medical profession as a whole, will proceed. The drug, which was discovered and developed by U.S. scientists, is already undergoing clinical trials in America for the treatment of all types of tubercular infection, dysentery, typhoid and para-typhoid fever, and certain types of infection of the urinary tract—particularly those which do not respond to penicillin or sulphonamides.

Indications are that streptomycin, which, like penicillin, is produced from a mould, will be the more expensive of the two on a

treatment basis. Although streptomycin is already in pilot-scale production in the U.S., supplies at present are so small that none can be made available to this country.

Applied Chemistry Classes

Day and Evening Courses

NORTHAMPTON Polytechnic, St. John Street, London, E.C.1, has issued its prospectus and syllabuses of part-time (day and evening) courses in applied chemistry for the new session which opens next Monday, September 30.

Evening courses are provided in chemistry, electro-plating, fuel technology and metallurgy, and part-time day courses in chemistry and metallurgy. The evening courses are intended for students able to attend on three evenings a week; at the same time, modified arrangements are made to meet the requirements of students unable to follow so comprehensive a course of study. A part-time day course in metallurgy is arranged to meet the requirements of employees released by their employers for one day a week throughout the session. Classes in chemistry in preparation for matriculation and Intermediate B.Sc. (Eng.) in engineering chemistry are also held.

Of particular interest are the part-time day and evening courses in glass technology, the former involving attendance for one day per week, while the latter involves attendance on three evenings. It is intended that the full course shall extend over three years and it will provide a theoretical background, together with instruction in the practice of glassworking.

In addition, a number of special courses has been arranged. A course of four lectures on "Electro-deposition Plant" will be given on Wednesdays, November 6, 13, 20 and 27, each beginning at 7.30 p.m. The fee for the course is 10s. Beginning on October 8, there will be a course of lectures on "Combustion and Furnace Practice" on Tuesday evenings at 7 p.m., for which the fee is one guinea, and on October 10 there will begin a course of lectures on "The Occurrence, Production and Properties of Solid Fuels" on Thursday evenings at 7 p.m., the fee again being one guinea. Admission to the special courses mentioned can be effected by personal enrolment at the Polytechnic any day between 10 a.m. and 7 p.m.

The Magnesium Association, New York, is arranging to hold an international magnesium congress in New York on October 3-4. Delegates will probably number 450. Major C. J. P. Ball, D.S.O., M.C., chairman of the board of Magnesium Elektron, Ltd., London, will be the principal speaker and guest of honour.

Casein

Its Manufacture and Applications

by GUY G. S. DUTTON, B.A., A.R.I.C.

THE appearance of finely ground casein leads many to suppose that it is related to cereal products such as wheat flour. In actual fact casein is a protein type of compound obtained from milk. All proteins contain carbon, hydrogen, nitrogen, many sulphur, and a few phosphorus. It is to this latter class of phospho-proteins that casein belongs. It may be said that casein is one of the proteins upon which most work has been done and this is attributed to the fact that it has been known from time immemorial and is easily obtainable in large quantities.

As shown in Table 1 the percentage of casein in different varieties of milk vary over fairly wide limits, there being 4.6 per cent. in sheeps' milk, while human milk contains only 0.5 per cent. It is a curious fact that despite the huge variety of proteins the constituent atoms are present with uniform regularity. Thus the percentages vary between the following limits: Carbon 52.55, hydrogen 6.9-7.3, oxygen 20.24, nitrogen 15.18, with small amounts of other elements. That these figures accord with the analysis of casein from various sources is illustrated by Table 2.

TABLE 1.
Casein Content of Typical Milks (per cent.).

	Cow	Sheep	Goat	Ass	Mare	Human
Water	87.80	83.5	85.0	89.5	91.2	88.3
Casein	3.20	4.5	3.7	0.8	1.3	0.5
Butter	3.50	5.2	4.7	1.6	1.0	3.0
Albumen	0.30	1.8	1.3	0.8	1.7	1.9
Lactose	4.75	4.8	4.3	5.7	5.6	6.5

TABLE 2.
Elementary Analysis of above Casein (per cent.).

	Cow	Sheep	Goat	Ass	Mare	Human
Carbon	52.69	52.92	52.90	52.57	52.36	52.24
Hydrogen	6.76	7.05	6.86	7.01	7.09	7.32
Nitrogen	15.65	15.71	15.48	16.28	16.44	14.97
Sulphur	0.83	0.72	0.70	0.59	0.53	1.12
Phosphorus	0.88	0.81	0.76	1.06	0.88	0.68

Despite the large amount of work which has been expended on the analysis of casein it is still not possible to ascribe a satisfactory formula. Suggestions which have been put forward vary from the two extremes $C_{166}H_{225}N_{41}SPO_{21}$ to $C_{173}H_{244}N_{44}SPO_{25}$. The molecular weight has been assigned a minimum value of 12,800, but from other considerations it is concluded that the actual molecular weight is about 192,000.

Further reference to Table 1 shows that ordinary milk contains a certain proportion of butter fat. This fat is removed from the milk before the latter can be used for the production of casein. This is necessary because the presence of the fat is detrimental to the casein and it also has a value in itself. The separation is normally

effected by passing the milk through a high speed centrifuge which will separate the fat leaving skimmed milk.

There are three main methods which may be used for the precipitation of the casein and the choice of the appropriate one will normally vary in accordance with the final use to which the casein is to be put. These three methods are: (1) Natural sour or lactic acid method, (2) rennet method, (3) sulphuric or hydrochloric acid method. The essential treatment of the milk, which in each case is slightly different, is set out below.

Lactic Acid Method

The skimmed milk contains its lactose, or milk sugar, content and, when this is acted on by lactic acid bacilli, fermentation takes place with the formation of lactic acid. The skimmed milk may therefore be left to stand in vats at the temperature most favourable to the action of the bacillus, but where production is on a continuous basis it saves time to add a small amount of the sour whey from a previous precipitation. It is customary to keep a certain amount of whey from day to day for this purpose. About 5-10 per cent. of whey will produce the right effect and, when the milk has developed sufficient acidity to give a soft curd, the milk is heated directly by steam. During this time the milk is vigorously stirred with long wooden paddles until a clear separation of the curd and whey takes place. In practice it is found that a temperature of about 110°F. gives the best results with the curd collecting in the bottom of the vat in a more or less solid mass with the whey on top but not containing small particles of curd.

The clear whey is drained off through a treacle valve over which is fastened a piece of cloth to catch any small pieces of curd that may still remain. At this stage the amount of whey required for following batches is preserved and allowed to sour. The curd remaining at the bottom of the vat is next washed with large quantities of water which have been acidulated to pH 4.8—the isoelectric point of casein. The curd is now placed in a hessian cloth whence the excess of water is allowed to drain.

Rennet Method

The precipitating agent for this method, rennet, is the saline extract from the fourth stomach of a calf. It is made up to a 2.5-5 per cent. solution in water and is added to the milk at the rate of 5-20 cc. per gallon while the temperature is maintained at

104°F. As soon as the curd has formed the whey is drained off and the curd cut up into lumps which are then heated to 150°F. to destroy the action of the rennet.

The concentration and the percentage of the rennet has very definite effects on the quality of the curd produced. The stronger the solution the firmer, drier, and more compact is the product. It is found that the action of the rennet below 65°F. or above 140°F. is imperfect, while generally round about 100°F. is found to be the best temperature with the amount of rennet adjusted to give complete precipitation in 20-30 minutes. During the addition of the rennet the mixture must be stirred continuously and it is a matter of great experience to get the speed correct. The addition of a small percentage of calcium chloride (0.01) gives a 3 per cent. increase in yield and a curd from which the whey drains more readily.

Acid Method

When precipitating with hydrochloric acid the milk is first warmed to 140°F.; the acid, which has been diluted with three parts of water, is then slowly added in a thin stream with constant stirring until the mass shows signs of clotting. The stirrers are then stopped and the curd comes down as a flocculent precipitate which is allowed to settle and from which the whey is drained. The curd is then washed with acidulated water, allowed to settle again, and the water run off. This process is repeated until the washings are clear and then the curd is removed and allowed to drain.

It must be emphasised that in the last two methods a trial test must be made in the laboratory to determine the amounts of precipitating agent necessary for the best results. This is essential, since no two lots of milk are ever the same, as they will vary according to the state of health of the cow, what the cow has been fed on, and the time of year.

Preparation by any of the above methods yields raw casein containing a large quantity of water which must be eliminated before the curd can be ground. This is done in two stages. The first stage consists in using a curd press which may be likened to a large letter press in which all the parts are made of well-oiled wood. The curd is spread out on to slatted boards several of which are then inserted into the press. When the curd comes out of the press it is in the form of hard sheets containing up to 50 per cent. water. To facilitate further drying the curd has to be broken up into small lumps and this is best effected by using a curd mill, the best types of which consist of two slowly revolving cylinders on which there are spikey teeth. These teeth break up the curd which falls to the bottom, there coming into contact with a

rapidly revolving arm which forces it through a medium mesh screen. The casein, which is now in the form of small lumps, is placed on trays so that it may be passed through a tunnel dryer. A type of dryer which is in common use has the following dimensions: the trays are often 30 in. square so that the tunnel is built 30 in. wide, 22 ft. long, and 6 ft. high. Such a tunnel will hold the casein from 30,000 lb. of milk when full. The hot air is supplied by a low-pressure fan at a temperature of 130-135°F., and it has been found that the best results are obtained if the amount of air entering the dryer is 4 cu. ft. per minute per lb. of curd. By almost any of the above methods 100 lb. of milk will give 7 lb. of moist casein which will itself yield 2 lb. of dry casein.

It is evident from these figures that the milk will be processed in the country of origin and that it will be the casein which is shipped as the raw material. The majority of industrial casein is prepared from cow's milk and it therefore follows that the most important casein-producing countries are those which have large surpluses of milk. These countries were the Argentine Republic, U.S.A., New Zealand, and India. Before the war the cost of skimmed milk in the Argentine was about 0.1d. per gallon compared with about 3d. per gallon in Ireland. The Argentine is still the main supplier of the world's casein; the material supplied is light yellow or cream coloured, very uniform from shipment to shipment, and gives a solution with a good medium viscosity. Indian casein made from buffalo milk used occasionally to appear on the European market, but since it varied greatly in quality owing to the crude methods of production it was not in great demand.

Grinding

Although casein cannot be described, from the point of view of grinding, as a hard raw material, nevertheless it does present some very tricky problems since the operation of grinding is one of the most important in converting the raw material into a form suitable for industry. It might therefore be expected that modern high-speed grinders would perform a better job than the old-fashioned grindstone. Such grinders have indeed been tried, but it has been found that the high speed produces a temperature sufficiently high to burn the casein and render it useless. Grinding is therefore carried out by means of French burr stones, after passing the material through a crusher mill if the casein is very hard.

The grinding process may briefly be described as follows. The unground casein, which arrives in this country in sacks, is tipped into a hopper underneath which is the crusher. In the hopper a series of

parallel magnets are situated in order to remove metal particles. From the crusher the casein emerges reduced to 30-mesh and it is then conveyed by an enclosed bucket elevator to the hopper for the burr mills. From the latter the ground casein is conveyed to a series of rotating sieves composed of hexagonal cylinders having walls of silk material stretched on formers. From these sieves casein of any desired mesh may be obtained by use of the appropriate silks but the most common grades normally met with are either 30, 60, 90 or 120-mesh.

The solubility of casein in water is only 0.11 g./litre at 25°C., but, owing to its acidic nature the solubility may be greatly increased by using an alkaline solvent. The most common industrial solvents are borax (15), ammonia (10), lime (25), sodium carbonate (5), and caustic soda (5). The figures in brackets indicate the approximate percentages required to dissolve good-quality commercial casein, although it must be realised that the actual amounts required will vary according to the acidity of the casein.

When preparing casein solutions it is important that the casein should all be of the same mesh. If the powder contains both coarse and fine grains it will be found that although the fine grains will dissolve readily it will be most difficult to get the coarser particles into solution.

Test of Quality

One of the easiest ways of deciding the quality of a sample of casein is to prepare a solution and note its appearance. A good sample of casein will dissolve completely, giving a pale cream-coloured solution, whereas poorer samples will invariably contain a sediment. For more accurate work the viscosity of a solution prepared in a standard way is a good guide to the quality. It is always found that poor caseins have a low viscosity, but the converse is not necessarily true since the value may be raised or lowered by the addition of small amounts of organic compounds. For most test purposes borax is used as the solvent and the casein, usually 90 mesh, is mixed dry with about 15 per cent. of borax, and the mixture then dissolved in water. If ammonia is used as the solvent it is best to add the casein to the correct amount of water, at a temperature not exceeding 120°F., and then the ammonia. It may be noted in passing that the working basis for all casein solutions is approximately 1 lb. to 1 gall. of water.

If it is desired to keep casein solutions, preservatives such as carbolic acid or thymol may be added. The rate of putrefaction of a casein solution depends to some extent on the nature of the solvent used. Thus a solution with a large excess of ammonia keeps for a long period without the addition of a preservative, but if sodium

carbonate or caustic soda is used putrefaction sets in quickly. An alternative preservative is nitrobenzene which may be used at the rate of $\frac{1}{2}$ to 1 per cent. and will also serve to keep the viscosity stable. A third use for nitrobenzene is for denaturing food casein which in most countries is a dutiable commodity. This is done by the insertion, into each container, of a sheet of absorbent paper soaked in the liquid.

Uses in Industry

(a) *The Paper Industry.* It has been estimated that between 60 and 70 per cent. of the world's casein production is absorbed by the paper trade. The printer's need for a paper capable of taking good half-tone impressions has led to the production of glazed papers produced by impregnation with inorganic fillers for which binders are necessary. Three common binders in use are glue, starch, and casein, but the amount used of the latter is much greater than the sum of the other two. The disadvantage of starch is that owing to the large size of the particles it will pick off easily while, glue has the unfortunate property of imparting a disagreeable odour to the paper. Casein suffers from neither of these disadvantages and in addition is easily rendered waterproof.

In Europe the only type of casein used for the paper trade is self-sour lactic which is imported straight from the Argentine. The casein is ground to 30-mesh before dissolving, since if it is ground to 90-mesh, although solution is speedier, there tends to be some insoluble grit from the grindstones. As the gloss of the paper is proportional to the amount of the fat, it is desirable to analyse the casein for this constituent before use. Among the inorganic fillers which may be used are satin white—a lake formed by slaking lime with aqueous aluminium sulphate—china clay, talc, and chalk. Satin white gives the highest gloss, provided that the other conditions are equal, while clay will work well with casein solutions, giving a finish only slightly less glossy than that achieved with satin white. Blanc fixe or precipitated chalk give matt or semi-matt finishes but neither is as waterproof as satin white. A typical formula is as follows: lactic casein 9, borax 2, blanc fixe 60, talc 1, water 24, and special soap solution 4 per cent. by weight. The special soap solution is made by boiling together carnauba wax 20, potassium carbonate 1.25, and water 72.75 per cent. A greater degree of waterproofness can be obtained by substituting caustic soda for the borax and, when solution is complete, adding aluminium sulphate equal in weight to $\frac{1}{2}$ times the weight of caustic soda employed.

To a lesser extent casein is used in the wallpaper trade where it has great value as a waterproofing varnish which may be ap-

plied to the paper after hanging or during manufacture. The solution must however be suitably modified in order to produce a flexible film. One other advantage is that when used in connection with silver and gold-patterned papers it prevents the metallic powder from being rubbed off or tarnished.

(b) *The Paint Trade.* At the present day casein is the most favoured binder in the preparation of distemper and similar water paints which are rapidly growing in importance owing to the ease with which they can be applied to a variety of surfaces. Casein-bound distempers do not rub off, they are washable, and they dry rapidly with a matt coat which for some jobs is an essential quality. To manufacture these paints the casein is mixed with a predetermined amount of hydrated lime. The quality of the lime is of prime importance and the quantity has to be accurately adjusted since if there is insufficient casein the paint will not be resistant to rubbing or the action of water, while if there is too much binder present not all the casein will be reconverted to the insoluble state and so is liable to peel off.

Purity of Tones

The purity of the tones that can be obtained is characteristic of casein paints. Pale yet vivid shades of red, grey, blue, green, and violet are made by using a little of the colouring matter with a large proportion of filler. The filler may be china clay, lime, powdered chalk, talc, or barytes, while suitable pigments are ochre, chrome green, carbon black, zinc white, etc. The casein, the filler, and the pigment are all ground separately and then sieved, after which they are put into a mixer where, owing to the different densities, it is found best initially to mix slowly and then gradually to increase the speed. It is found that the pale shades require less casein than the dark pigments and that those paints which have organic colours require less than those where inorganic colouring matter is used. The nature of the surface to which the distemper is to be applied also regulates the amount of casein to be used. Thus, if the paint is to be used on a firm base such as cement, the colour should contain more casein than if it is going to be used on plaster; in the latter case, where the tendency to peel off is very noticeable, the casein content is reduced while that of the lime is increased.

Modern distempers contain linseed oil in addition to casein which gives added durability and water proofness. For outside work a paint with almost the same degree of hardness as an oil paint may be made by incorporating a little magnesium silicate in the mixture.

Although casein distempers dry with a

matt coat this can be brightened for interior work by spraying the finished surface with waxes dissolved in turpentine. When working with casein paints it is essential to see that a greater quantity of solution is not made up than can be used in one day, since after 12 hours casein paints begin to lose their adhesiveness.

Although much time and research has been expended on trying to find a suitable plasticiser for casein, no success has yet been achieved. If this were possible the scope of casein paints would be greatly increased since they could be used for coating articles where a thin flexible film is required and at the same time the casein cinema film would become a possibility.

(c) *The Plastics Industry.* The foundation of this important industry dates from 1897 when the German Ministry of Education offered a prize for a slab which was to be white and washable and upon which one could write with a lead pencil, the intention being to replace the school slate. The prize was awarded to a Mr. Krische who had the idea of coating a piece of cardboard with a casein solution and then waterproofing it.

The casein plastics industry cannot be said to have started in Great Britain until 1909, and in subsequent years its importance greatly increased although it is not being displaced by more modern synthetic materials. This is illustrated by the fact that it has recently been reported that no new machinery has been installed in German casein plastic factories since 1930.

Preparation of Plastics

For the preparation of plastics the casein is charged into hoppers, which act as a measure for each mixing machine, and is then mixed with fillers in a dry state. During this mixing the dye is dissolved in the minimum quantity of water and is then sprayed on to the mix. The next operation is the extrusion; this is carried out in an extruder which consists essentially of a water-jacketed worm, arranged so that the whole mass can be uniformly heated, inside a box fitted with a nozzle. As the worm turns, the mix is forced out through a nozzle giving either rods or tubes according to the construction of the nozzle. If it is desired to produce a mottled pattern, as for fountain pens, coloured rods are made by extrusion and then hardened. They are cut into 5-mm. lengths called nibs, and then mixed with a fresh charge of the basic colour material. This is then passed through the extruder in the usual way but the nibs, having been previously hardened, will stand out from the base material, giving the desired effect.

When the material is required in sheets these rods are cut up into lengths of 6-8 in. and placed between steel sheets where they are steam heated and subjected to pressures of 150-200 tons. When the sheets emerge

they are still fairly soft but rigid enough to stand upright in tanks of formaldehyde. Here the sheets are left to stand for a time dependent on their thickness, after which they are dried by a stream of air heated to 27-32°C. During this drying process the sheets are inclined to warp, so that they are afterwards straightened with a hydraulic press.

Two methods are employed for polishing the sheets. The first of these, known as the buff method, consists of rubbing the material with fine-grade carborundum and then with canvas and swansdown buffs, using special fine powders. The second method is of a chemical nature and consists of using a bath containing sodium hypochlorite 1 part, water $8\frac{1}{2}$ parts, and to every 10 gallons of solution are added 8 oz. of caustic soda. The articles to be polished are immersed in the solution at a temperature of 60-70°C. for 2-3 minutes. The articles are then placed in clean water at the same temperature, after which they are dried. With delicate shades it is sometimes found that a certain amount of discoloration will take place. This may be prevented by the addition of two pints of 100 vol. hydrogen peroxide to every 10 gallons of the solution.

Disadvantages

Two of the main disadvantages of casein plastics are that at 130°C. the plastic may show signs of discolouring, although this is only noticeable with delicate colours; but at 160°C. all colours are affected. In addition the material is to some extent hygroscopic which makes it unsuitable as an insulator for high-tension work although it is suitable for low tensions.

(d) *Food and Medicinal Applications.* Food casein is made in much the same way as commercial casein precipitated with hydrochloric or sulphuric acids, except that in the place of these acetic acid is used as the coagulating agent. (The importation of food casein has been prohibited since the early days of the war.) The acetic acid is added as quickly as possible in order to produce a hard curd, which, after washing with water, is dried and mixed with the calculated amount of sodium carbonate, the latter acting as the solvent when the casein is dissolved in water. Since the percentage of phosphorus in casein is small it is often desirable to incorporate some additional phosphorus in the finished product. This is done by adding sodium or other glycerophosphates. An analysis of a typical food casein (Laitproton number 6) is: protein 92, fat 0.75, and ash (including phosphates of sodium, etc.) 7.25 per cent. An important fact which is not revealed by the above analysis is that the casein still contains the valuable enzymes present in fresh milk.

Since human digestion is mainly intesti-

tinal, whereas that of the cow is stomache, cow's milk is not greatly suited to small infants as it tends to form lumpy curds in their stomachs. Children's foods often contain food casein mixed with sodium citrate which latter increases the amount of calcium present by reversible double decomposition; this in turn retards the action of the coagulating enzymes, so that when coagulation does occur a soft curd is produced which the infant can manage with greater ease.

Other Applications

Among other applications of casein in the food trade are its uses for glazing pies, sausage rolls, etc., and for incorporation into ice cream in order to impart a smooth texture, besides giving it some food value.

In the cosmetic industry casein finds its main outlet in the production of cleansing creams, where its adhesive properties are used to extract dirt from the pores of the skin. Compounded with metals it finds a variety of uses: e.g., ferric caseinate is used as a tonic and blood improver, while a bismuth compound is used for dressing wounds.

(e) *The Leather Industry.* The seasoning of leather used to be carried out by such natural products as Irish moss and blood albumen, but these are now obsolete, their place having been taken by casein finishes. It is estimated that about three million gallons of leather-dressing are used in the U.K. per annum and casein is the most important constituent in the majority of these finishes.

Seasoning is the last operation performed on the leather before it leaves the tannery to be made up. It consists in the application to the grain surface (i.e., the outside of the animal's skin) of a solution which will impart a gloss to the leather. This is achieved by applying a casein solution and then rolling the leather between glass cylinders. Although the gloss produced by casein is not so good as that from blood or egg albumen it has the advantage that it will last longer owing to its superior waterproof qualities.

(f) *Glues.* The status of the casein glue trade is much the same as that of the plastic trade, that is to say that although casein glues have been of the very greatest importance they are now being replaced by various synthetic resins. Casein glues have been known for a long time, but one of the factors contributing to their development was the great demand in the first World War for aeroplanes which were made of wood and had laminated wooden propellers. An idea has grown up that casein which is not fit for anything else can be used for making glues. This idea is quite erroneous and the quality has a decided effect on the strength of the glue. In this connection it has been shown by the British Adhesive

Research Committee that the presence of fat does not effect the waterproof qualities, but the strength is greatly diminished, while excess of an inorganic salt will cause brittleness. The earlier casein glues were troublesome to use, since once the solution had been prepared it would not stay open for very long, but this has been overcome by the introduction of a very small percentage of sodium sulphate.

Government Control

Since casein is derived from milk it is obvious that the supply will vary with the seasons, and this, together with certain other causes, results in wide fluctuation in price. In order to control dollar purchases all casein during the war was bought by the Ministry of Supply which function is now carried out by the Board of Trade. This department is assisted by the Lactic Casein Importers' Association at 23, St. Swithins Lane, London, E.C.3, and application should be made to them for licences to purchase, stating the purpose for which the casein is required.

The Montecatini Group

Senator Abbiate's Speech

DETAILS have just been received in this country of an interesting speech made by the president of the board of administrators of the Montecatini group, on the occasion of a recent extraordinary general meeting. On the general situation of Italy's industry, Senator Abbiate remarked that it was characterised by marked differences in the operating conditions among individual enterprises in each main group of industries. While certain industries had to struggle against serious difficulties, there were others in which the volume of production had almost reached a normal level. In those spheres of industrial activity which are controlled by the Montecatini group, conditions might, on the whole, be described as middling. As a result of a close co-operation between the company and its workers and employees, output, which had at one time fallen very low, had been increased and in a number of cases the most favourable production targets had even been surpassed. Special progress had been made in the group's mining activities; for instance, output of pyrites for the first four months of the current year was equal to the whole of last year's output, and the subsequent months have witnessed further improvement. A considerable increase in the annual output of pyrites has thus to be reckoned with, which, it is hoped, should allow of appreciable quantities for export. In view of Italy's

poverty in home-produced fuels, special significance attaches to the progress made in the Ribolla coal mines. Satisfactory reports on the group's production of sulphur and bauxite continue to come in, but the slow revival of building activities has, so far, obstructed an increase in the output of marble.

Production in the Montecatini chemical works amounts at present to about 50 per cent. of the normal pre-war level. An improvement in the fertiliser supply position is expected as a result of larger imports of phosphate rock, and it is hoped that it will soon be possible to meet the farming community's substantial requirements for phosphate fertiliser. Deliveries of nitrate fertiliser and of insecticides have steadily improved in recent months and production of copper sulphate—an item of special importance to Italy's agriculture—has attained a level that has not been attained for a good many years past. The rehabilitation of war-damaged fertiliser plants has been given priority and a start has been made with the erection of additional new units. As a result of the efforts made in the fertiliser sector, Italy should soon possess a modern and efficient fertiliser industry.

As to the production of dyestuffs by the Montecatini's subsidiary, the "ACNA" (Azienda Colori Nazionali Affini), in which the I.G. Farben formerly held 49 per cent. of the share capital, lack of coal has made it impossible to satisfy domestic demand. However, a marked improvement in the quality of the company's products has been noted in recent months. The plants of the Società Farmaceutici Italia ("Farmitalia"), at Settimo Torinese, which have been established in co-operation with the French Rhône-Poulenc group, and which had suffered no war damage worth mentioning, report a satisfactory volume of activity. Output of plastics and of varnish is at present higher than before the war, and satisfactory progress has also been made in the manufacture of products required by the metal, textile, and paper industries.

While the position of the group's explosives sector, many units of which were seriously damaged during the war, is said to be unsatisfactory, the Società Industria Nazionale Alluminio ("I.N.A."), another subsidiary engaged in the manufacture of aluminium with plants at Mori and Bolzano, reports a high level of employment, regardless of the generally easy situation on the world aluminium market. The Monteverchio-Società Italiana del Piombo e dello Zinco, a subsidiary engaged in the production and smelting of lead and zinc, has staged a remarkable recovery after its Sardinian smelter had been idle for 28 months.

Personal Notes

DR. T. F. DIXON, biochemist to British Drug Houses, Ltd., has been appointed Professor of Biochemistry at the Royal Medical College, Baghdad, and expects to assume duty at the end of next month.

MR. JOHN SHEARER, M.A., B.Sc., principal science master at Stromness Academy, has been appointed Director of Education for Orkney and executive officer of Orkney Education Committee.

MR. H. M. GALE, who has been a research engineer with A. Reyrolle & Co., Ltd., Hebburn, for 15 years, is to take up a new appointment on October 1 with Elliott Bros. (London), Ltd., makers of scientific instruments, who are opening a new research station at Elstree.

MR. A. E. TUCKER, who recently retired after 47 years' service with Walworth, Ltd., the last 22 years as warehouse superintendent, has been presented by his friends in the company with a suitably engraved watch, to commemorate their long and pleasant association. He has been succeeded by Mr. Albert G. Cook, who has been with the company for 21 years.

PROFESSOR P. M. S. BLACKETT, PROFESSOR M. POLANYI, and SIR HAROLD HARTLEY are among the distinguished scientists and scholars who have accepted invitations to participate in the first series of conferences (starting this week) by which the bicentenary of Princetown University is being commemorated. The series of conferences, convocations, etc., will continue throughout the academic year, ending in June 1947.

MR. E. S. LITTLE has been appointed a director of Associated Electrical Industries Finance Co., Ltd., which is concerned with the financial operations of all the companies of Associated Electrical Industries, Ltd., including the British Thomson-Houston Co. In consequence of his new appointment, Mr. Little has retired from the board of the British Thomson-Houston Co., Ltd., but he continues to be comptroller and secretary of that company.

DR. F. A. FREETH, F.R.S., technical adviser to the Central Staff Department of I.C.I., who has been representing the Chemical Society, the Faraday Society, and the Society of Chemical Industry at the 20th Congress of the Société de Chimie Industrielle in Paris during the past week, has been made an honorary member of the French Society of Chemical Industry.

MR. GEOFFREY HEYWORTH, who is chairman of Lever Bros. and Unilever, Ltd., and vice-chairman of its sister company, Lever Bros. and Unilever Mij., has accepted the invitation of the Lord President of the Council to be chairman of the Advisory

Council for Scientific and Industrial Research, as from October 1, in succession to Lord Riverdale, who is retiring after holding the appointment for nine years. The Lord President has appointed PROFESSOR H. W. MELVILLE, Professor of Chemistry at Aberdeen University, to be a member of the Advisory Council, from the same date, in succession to Sir Franklin Sibly.

Obituary

MR. BENJAMIN LEECH, M.A., F.R.I.C., of Macclesfield, Cheshire, who is presumed to have been lost in a gale while sailing in the Mersey Estuary with two friends on September 14, was well known in Cheshire as a consulting and analytical chemist, in private practice. He was formerly associated with the firm of Mary Leech, dyers, and was on the consulting staff of Macclesfield General Infirmary. He was an experienced yachtsman and held a captain's certificate.

Institution of Chemical Engineers

Associate-Membership Examination

OF the 52 candidates who presented themselves for the 1946 Associate-Membership Examination of the Institute of Chemical Engineers, 35 satisfied the examiners, seven were failed, and ten were referred in certain sections. The general standard of the answers was less high than in the last few years; the drawing paper was again poor, some of the candidates, indeed, giving no evidence that they had any knowledge of projection, while others were very inexperienced in reading drawings.

The following list gives the names of the successful candidates, among whom Mr. B. J. GEE has been awarded the William Macnab Medal as a result of his examination work, while the papers of Mr. D. E. B. GREENSMITH were very highly commended.

Pass List

MESSRS. K. ASTIN, E. BAILEY, R. F. BAILEY, I. BERKOVITCH, C. O. BISHOP, W. R. BULCRAIG, H. W. CHATFIELD, A. L. CUDE, R. A. L. DAVIES, R. ELLISON, R. R. FERNER, R. GARDNER, B. J. GEE, D. E. B. GREENSMITH, K. GRIFFITHS, E. HENRY, G. HOLLAND, R. HUTT, E. R. B. JACKSON, H. JACKSON, J. K. LORD, J. F. MATTHEWS, T. G. MEYRICK, K. OWEN, G. H. RADFORD, R. B. RISK, J. B. SEED, L. C. SUMMERVILLE, C. H. SWEDLER, F. H. H. VALENTINE, O. B. VOLCKMAN, J. C. VOSKAMP, W. A. WANSBROUGH-JONES, R. G. WILLIAMS, and J. WOOD.

The Council has decided that the fee for the 1947 and subsequent examinations shall be increased to £5 5s.

General News

Dr. J. H. Quastel's brilliant lecture on "Soil Metabolism," delivered in London last year, has been issued in pamphlet form by the Royal Institute of Chemistry, and forms an essential weapon in the armoury of the agricultural chemist.

Townson and Mercer, Ltd., Croydon, is the new address of that firm. Their new permanent factory, stores and offices adjoin Beddington Lane Station, on the edge of Mitcham Common. The telephone number is Mitcham 1161.

A Board of Trade booklet, now available at H.M. Stationery Office, contains a list of Government goods and raw materials which may become surplus, with names and addresses of the departments responsible for disposal and their liaison officers.

Candidates for the examination for the Associateship of the Royal Institute of Chemistry, which will be held in the week beginning January 20, 1947, are reminded that their applications must reach the Institute by November 4, while their entry forms must be received by November 11.

Organon Laboratories, Ltd., will be employing about 500 persons at their new Scottish factory on the Newhouse Industrial Estate, Lanarkshire, when the factory is in full production. Houses are being erected at the neighbouring township of Holytown, for key workers at this and other new factories on the estate.

It is reported from Scotland that the "Britain Can Make It" exhibition may be transferred there for a month early in 1947. A formal resolution was passed by the Scottish Council of Industrial Design recommending to the Board of Trade that the exhibition be sent to the Kelvin Hall, Glasgow.

Under the terms of the will of the late Mr. G. S. Albright, a director of Albright and Wilson, Ltd., chemical manufacturers, Oldbury, who left £507,972, on which £185,948 duty has been paid, three of thirty-two parts of the residue are bequeathed to the trustees of a deed to be held on trust for the benefit of the staff and workpeople of Albright and Wilson, Ltd.

The formation of a society concerning itself with photoelasticity was discussed at a recent meeting at University College, London. It was decided to extend the scope to other techniques of experimental stress analysis and to form an informal group for the interchange of knowledge and experience. Readers who are interested in experimental stress analysis are invited to communicate with the hon. secretary, Mr. E. K. Frankl, Engineering Laboratory, Cambridge.

From Week to Week

A monograph on "Microchemistry and its Applications" has been published by the Royal Institute of Chemistry. It is the work of Mr. Ronald Belcher, F.R.I.C., who is among the soundest and most trustworthy authorities on the subject, and is based on three lectures delivered in 1940-44, forming an admirably concise and useful manual for all workers concerned.

The severe flooding in Yorkshire during the latter part of last week resulted on Friday in 400 workpeople being sent home from the Deighton works of I.C.I., Ltd., after the River Colne had burst its banks and flooded one section of the plant. Firemen had the task of pumping 15,000 gallons of flood water from the Yorkshire Coking and Chemical Co., at Castleford, in order to prevent the water rising to a level at which the entire plant would have been put out of action.

At the annual sales conference of Vitax Fertilisers, Ltd., held recently at Liverpool, future plans were dealt with and exhibits of new or prospective lines were on show. A dinner at the Adelphi Hotel closed a day which was felt to have been extremely instructive. Present were the directors, Mr. G. W. Wagg (general sales manager), Mr. H. Stansfield (works manager and chemist), and Mr. A. O. Rylance (export manager), together with salesmen and technical staff, and key members of office and factory staff.

Foreign News

Demand for DDT in South Africa is mounting, according to the Minister of Economic Development.

From Finland it is reported that fertilisers in that country will be in short supply throughout this year.

A team of experts from Britain has been visiting Northern Rhodesia to investigate the possibilities of a highly mechanised groundnut production on a large scale to combat the world fat shortage.

Considerable prospecting is reported to be in progress in the Ibadan area of Nigeria, where new areas are being opened up. Discoveries of talc are being worked and inquiries for tantalite have been received.

The military government of the American zone of Germany announces that the Allies have prohibited the use in future of the name of the I.G. Farben, and the trade mark of the trust on products manufactured in those of its plants to be maintained in operation.

Every effort is being made by the Soviet Russian authorities to exploit the mineral wealth of Sakhalin and the Kurile Islands.

The Battelle Memorial Institute, Columbus, Ohio, now has a staff of 860, and, according to the latest reports, did about \$3,000,000 worth of research for industry during the past year. A convenient list has now been published, cataloguing and indexing the 819 books, publications and patents issued by the Institute during the period 1929-44.

Because the Italian Government has issued a decree providing for a 25 per cent. capital levy in the case of a capital increase carried out by means of a revaluation of assets, the board of the Montecatini group has decided to suspend, until further notice, the proposed increase of the capital from two to eight million lire, agreed upon at a recent extraordinary meeting.

Construction of an oil refinery near Valparaiso, Chile, is planned by the Corporación de Fomento de la Producción, the Caja de Nacional de Amortización and the Chilean State Railways at a cost of U.S. \$10,000,000. It is intended that the plant, which will be designed for a capacity of 10,000 barrels daily, will be used to refine imported oil until production from the Punta Arenas oilfield becomes available.

Hitherto known mainly for its production of industrial inorganic chemicals, the Wyandotte Chemical Corp., Wyandotte, Michigan, is embarking on the manufacture of fine and organic chemicals. Two large plants, one turning out glycols, the other synthetic detergents, will be completed in the course of 1947. The capacity for manufacturing soda ash and calcium carbonate is likewise being greatly extended.

Paper manufacturers in Holland are reported to be suffering from a shortage of chemicals. Stocks received from Germany during the occupation are nearing depletion; salt cake used in making sulphate paper is in very short supply and sizing materials are badly needed. Some chlorine has been imported from Switzerland, but supplies are inadequate. A heavy demand exists for rosin from the United States, as European sources are restricted.

The erection of plant for the extraction of oil from the shale of the Gévaudan at Sévérac-le-Château (Aveyron) in S.E. France has aroused interest in the allied deposits in the district. An article by V. Charrin in *Chimie et Industrie* (1946, 56, 1, p. 69) gives full details of these "pyroschistes," the average oil content of which appears to vary between 4 and 9.6 per cent., with an average of 6.6.8 per cent. (perhaps a rather optimistic figure). The oil-bearing seam at Sévérac is about 15 metres thick, and can be quarried from the surface.

Reconstruction work has begun on the oil refinery at Saint-Pol-sur-Mer, near the port of Dunkirk, which was totally destroyed in 1940. The new installations will allow the treatment of 900,000 tons of crude oil a year, against a pre-war capacity of 500,000 tons. The work will, it is hoped, be completed by 1949.

The Spanish textile firm, Peinaje e Hilatura de Lana S.A., of Tarrasa, near Barcelona, has applied for permission to erect a plant for the purpose of recovering the wool grease and potash salts obtainable from the liquid residues of the wool industry. An annual production of 150,000 kg. is contemplated.

Forthcoming Events

October 2. North-Western Fuel Luncheon Club. Engineers' Club, Albert Square, Manchester, 12.30 for 12.45 p.m. Sir John C. Dalton: "Fuel Technologists and Nationalisation."

October 2. Institution of Works and Factory Managers (Midland branch). Queen's Hotel, Birmingham, 7 p.m. Mr. C. R. Jordan: "The Different Problems Arising in the Management of Small and Large Factories."

October 2. Society of Public Analysts. Chemical Society's Rooms, Burlington House, Piccadilly, London, W.1. 6 p.m. Mr. G. G. Freeman and Mr. R. I. Morrison: "The Determination of Some Products of Sugar and Molasses Fermentations"; Mr. T. G. Bonner: "The Estimation of Moisture in Propellant Explosives by an Improved Fischer Method"; Mr. A. H. Edwards: "The Analysis of Barium Carbide."

October 3. Oil and Colour Chemists Association (London Section). Royal Institution, 21 Albemarle Street, London, W.1. 6.30 p.m. Professor H. W. Melville: "The Chemistry of High Polymers—I."

October 3. The Chemical Society. Burlington House, Piccadilly, London, W.1. 7.30 p.m. Mr. J. M. Robertson and Mr. J. G. White: "The Crystal Structure of Pyrene: A Quantitative X-Ray Investigation"; Mr. R. F. Barrow, Mr. C. J. Danby, Mr. J. G. Davond, Mr. C. N. Hinshelwood and Mr. L. A. K. Staveley: "The Re-distribution and Desorption of Adsorbed Gases."

October 4. Society of Chemical Industry (Manchester Section). Lecture Theatre, Central Library, St. Peter's Square, Manchester, 6.30 p.m. Professor E. K. Rideal: "Physical Chemistry in the Dyestuffs Industry" (First Ivan Levinstein Memorial Lecture).

October 7. Oil and Colour Chemists' Association (Hull Section). Royal Station

Hotel, Hull, 6.30 p.m. Mr. G. H. Harries: "The Evaluation of Crude Petroleum Oils."

October 7. Society of Chemical Industry (London Section). Chemical Society's rooms, Burlington House, Piccadilly, London, W.1, 6.30 p.m. Dr. W. H. J. Vernon: "Chemical Research and Corrosion Control: Some Recent Contributions of a Corrosion Research Group."

October 8. Institution of Chemical Engineers. Geological Society's Rooms, Burlington House, Piccadilly, London, W.1, 5.30 p.m. Mr. D. G. Murdoch and Mr. M. Cuckney: "The Removal of Phenols from Gas Works Ammoniacal Liquor."

October 10. Oil and Colour Chemists' Association (London Section). Royal Institution, 21 Albemarle Street, London, W.1, 6.30 p.m. Professor H. W. Melville: "The Chemistry of High Polymers—II."

October 11. Society of Chemical Industry (Chemical Engineering Group). Geological Society's Rooms, Burlington House, Piccadilly, London, W.1, 5.30 p.m. Mr. R. Scott, A.M.I.Chem.E.: "Chemical Engineering in the Tar Industry."

October 11. Society of Public Analysts (Physical Methods Group, jointly with Cardiff and district section of the Royal Institution of Chemistry and South Wales section of the Society of Chemical Industry). University College, Cathays Park, Cardiff, 6.30 p.m. Mr. A. D. E. Lauchlan: "Recent Developments in Apparatus for pH Measurement and Electro-titrations"; Mr. R. J. Carter: "Some Applications of Electrometric Methods of Analysis"; Dr. D. P. Evans: "Polarisation End Points."

New Companies Registered

Dytex (Scotland), Ltd. (418,791).—Private company. Capital £100 in 1s. shares. Manufacturers of and dealers in dyes and chemicals of all kinds, etc. Directors: E. Dee; B. Krenin. Registered office: Oxford Circus House, 245 Oxford Street, W.1.

Technotex, Ltd. (419,149).—Private company. Capital £1000 in £1 shares. Producers and manufacturers of and dealers in machinery, chemical goods, technical and chemical equipment, etc. Subscribers: A. Frigyes; S. Darvas. Registered office: 6 Bank Chambers, Station Road, Finchley, N.3.

Melwood Thermoplastics, Ltd. (418,901).—Private company. Capital £5000 in £1 shares. Manufacturers of and dealers in thermoplastic and plastic substances, materials, compounds and solutions, particularly polyvinyl chloride, polyvinyl acetate and polyethylene extrusions and mould-

ings, manufacturers of goods made of rubber, rubber-like substances and synthetic rubber, etc. Directors: F. K. Hollywood; A. W. Meldrum, 18 Old Park Ridings, Grange Park, N.21 (chairman).

Company News

The nominal capital of the **Morgan Crucible Co., Ltd.**, Battersea, has been increased beyond the registered capital of £4,237,000 by the addition of £350,000, in £1 "A" ordinary shares.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

JOHNSON & SONS MANUFACTURING CHEMISTS, LTD., London, N.W. (M., 28/9/46).—August 28, £15,000 debenture, to Abchurch Nominees, Ltd.; general charge. *£31,283. November 21, 1945.

Receivership

ANSOL CHEMICAL CO., LTD., 4 Broad Street Buildings, E.C.2 (R., 28/9/46). E. C. Smith, chartered accountant, of 44 Brazen-nose Street, Manchester, was appointed receiver and manager on August 9, 1946, under powers contained in debenture dated May 7, 1946.

Chemical and Allied Stocks and Shares

STOCK markets were more disposed to move with the trend of Wall Street this week, and buyers showed a waiting attitude pending international developments. The Argentine, Brazilian, and French agreements helped sentiment, although Argentine rails lost part of last week's substantial gains. Strength was again displayed by British Funds. Industrials have been dull, prices losing ground owing to the small buying interest in evidence. Little selling was reported.

Imperial Chemical receded, but later firmed up to 42s. in anticipation of the interim dividend. Dunlop Rubber went back to 71s. 9d., and Courtaulds to 52s. 6d., while Turner & Newall were 85s., and

United Molasses 51s. 9d. Lever & Unilever firmed up to 54s., and Lever N.V. to 54s. 4½d. pending a statement regarding the Dutch company's dividend. Triplex Glass, awaiting the preliminary results, fluctuated around 40s. 3d., but there was a better trend in paint shares, helped by increases in recent interim payments. International Paint moved higher to £63½ xd on the increased interim. Paripan 5s. ordinary were 32s., the interim having also been raised in this case; while Pinchin Johnson, on hopes that the forthcoming interim may be stepped up, have touched 45s. 6d. Goodlass Wall at 29s. 9d. were also higher, and Lewis Berger firm at £6 11/16 in response to market dividend estimates.

B. Laporte were again 100s., Fisons changed hands around 60s., W. J. Bush were 90s., and British Drug Houses 55s., while British Glues & Chemicals 4s. ordinary attracted buyers and moved up to 16s. 3d. Monsanto Chemicals 5½ per cent. preference were 25s., and Morgan Crucible first preference 28s. 9d. Greff-Chemicals Holdings 5s. ordinary held firm at 12s. 6d. Blythe Colour 4s. ordinary were 46s. 3d., and William Blythe 3s. shares 13s. 9d., the latter remaining under the influence of the increased interim dividend.

Iron and steel shares lost part of their recent steadiness, the latest statements having indicated that, although postponed for the time being, the Government plans to nationalise the industry will operate during the present Parliament. Dorman Long were 26s. 4½d., United Steel 26s., and Stewarts & Lloyds 51s. 9d. On the other hand, colliery shares continued to be favoured on estimates of their break-up value and also on hopes of increases in forthcoming dividends. Powell Duffryn were 24s. 3d., and Bolsover 59s. Staveley moved higher at 55s. on further consideration of the strong position shown by the recently-issued accounts and the attractive yield on the higher dividend basis. Similar factors drew attention to Sheepbridge (46s. 6d.) the accounts having also been issued recently in this case.

Boots Drug eased to 60s. 4½d., and Beechams deferred at 26s. 3d. lost part of an earlier rally. Griffiths Hughes were 61s. Aspro also eased to 39s. 3d., but remained active awaiting the dividend announcement. Sangers held firm at 34s. 6d. Metal Box shares were 115s., and British Match 47s. 3d. Low Temperature Carbonisation 2s. ordinary showed activity around 3s. 7½d. Amalgamated Metal were 19s. 3d., and Imperial Smelting 19s. 9d. Oils, after earlier firmness, eased, but declines on balance were small, Shell being 92s. 6d., Anglo-Iranian 98s. 1½d., and Burmah 67s. 3d. xd. Trinidad Leaseholds and Trinidad Petroleum were well maintained, and there was activity up to 15s. 6d. in Mexican Eagle Oil on revived rumours of resumption of negotiations

with the Mexican Government; but later the price fell to 14s. 7½d., subsequently recovering to 15s. Elsewhere, Distillers moved back to 132s. 6d. De La Rue at 12½ lost the rise which followed official confirmation that the £1 shares are to be "split" into four of 5s. each.

British Chemical Prices

Market Reports

AFIRM tone characterises the London general chemicals market and there is continued pressure for deliveries against contracts. Buying interest has been spread over most sections of the market and export inquiry has been on a good scale. In the soda products section there has been a steady demand for the photographic and technical grades of hyposulphite of soda, while a persistent call for supplies of chlorate of soda and bichromate of soda is reported. Among the potash products both caustic and carbonate of potash are in good call, while permanganate of potash is firm on a good demand. In other directions a steady demand is reported for arsenic, formaldehyde, and the heavy acids, and there has been no falling off in activity in the lead compounds. Firm price conditions have been maintained in the coal-tar products market, with pitch in active request.

MANCHESTER.—A strong undertone remains a feature in virtually all sections of the Manchester market for both light and heavy chemical products, and in several directions the tendency is towards higher levels. The textile bleaching, dyeing, and finishing trades are all taking steady supplies under contracts, and these and other industrial users have been in the market with replacement orders. Export inquiries during the week have been on a fair scale, and additional business has been arranged. Most descriptions of tar products both in the light and heavy sections are being called for in good quantities.

GLASGOW.—There has been considerable activity during the past week in the Scottish heavy chemical trade, all classes of chemicals and raw materials being in great demand both for home and export trade, although available supplies are still insufficient to meet the demand.

Price Changes

Glycerine. MANCHESTER: Chemically pure, double distilled s.g., in tins, £4 16s. 6d. to £5 10s. 6d. per cwt., according to quantity; in drums, £4 2s. 6d. to £4 16s.

Lead Nitrate. MANCHESTER: £70 to £72 per ton d/d in casks.

Oxalic Acid. MANCHESTER: £5 to £5 2s. 6d. per cwt.

Salicylic Acid. MANCHESTER: 1s. 9d. to 2s. 1d. per lb. d/d.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted may be obtained from the Patent Office, Southampton Buildings, London, W.C.2., at 1s. each. Numbers given under "Applications for Patents" are for reference in all correspondence up to acceptance of the complete specification.

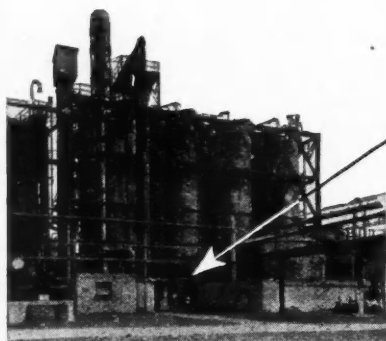
Applications for Patents

Penicillin salts.—Commercial Solvents Corporation. 25190-1.
Coating compositions.—E.I. Du Pont de Nemours & Co. 24888.
Treatment of monofilms.—E.I. Du Pont de Nemours & Co. 25099.
Polyvinyl esters.—E.I. Du Pont de Nemours & Co. 25199.
Polyamides.—E. Ellery, and I.C.I., Ltd. 25096.
Insecticides.—J. Fechtner. 25255.
Copper base alloys.—J. G. Gaunt (Beryllium Corporation). 25296.
Pesticidal composition.—B. F. Goodrich Co. 25069.
Organic compounds.—J. D. Kendall and H. D. Edwards. 24735.
Ricinoleates.—E. M. Meade and Lankro Chemicals, Ltd. 25014-5.
Insecticides.—Merek & Co., Inc. 24996.
Vitamin compounds.—Ortho Pharmaceutical Corporation. 24771-7.
Carbon black.—Phillips Petroleum Co. 25415.
Chlorinating plants.—Progil. 25109.
Polymers.—Ridbo Laboratories, Inc. 25420.
m-Aminophenol derivatives.—Roche Products, Ltd. (F. Hoffmann La Roche & Co.). 25332.
Formamide derivatives.—Roche Products, Ltd., A. Cohen and J. A. Silk. 25331.
Plastic films, etc.—Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny & Cirey. 25422.
Sulphur dioxide.—Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny & Cirey. 25422.
Hydrogenated oils.—A. H. Stevens (Armour & Co.). 25078.
Hydrocarbons.—Universal Oil Products Co. 25412.
Organic compounds.—Universal Oil Products Co. 25413.
Extraction of alkaloids, etc.—Usines Chimiques des Laboratoires Français. 25484.
Sulphur compounds.—Ward, Blenkinsop & Co., Ltd., A. A. Goldberg and H. S. Turner. 25282-3.
Sulphurised oils.—Anchor Chemical Co., Ltd., and K. C. Roberts. 26091.
Hydrocarbons.—J. C. Arnold. (Standard Oil Development Co.) 25868.
Nitro compounds.—Boots Pure Drug Co., Ltd., J. Cymerman, and W. F. Short. 26179.
Cellulose derivatives.—British Celanese, Ltd. 25830.
Polymers.—British Thomson-Houston Co., Ltd. 25834.

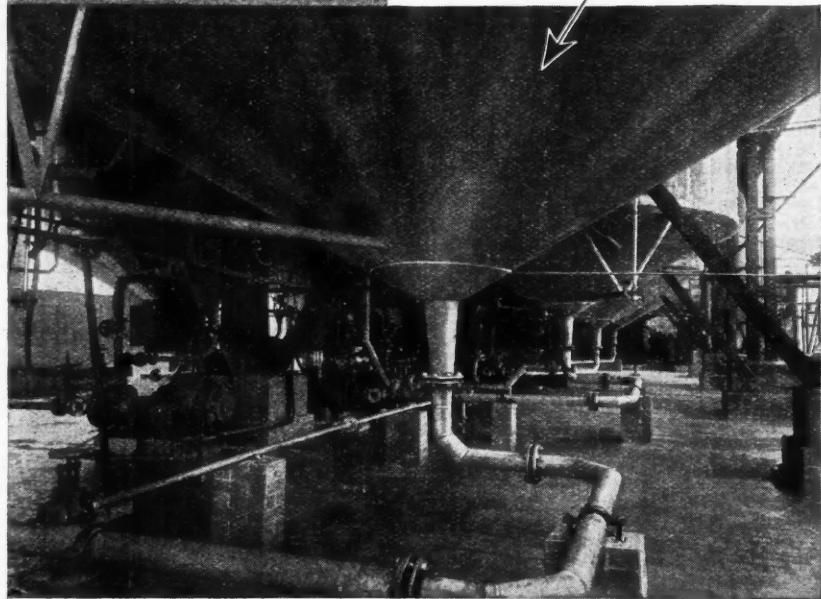
Carboxylic acids.—W. J. Bush & Co., Ltd., and H. W. Vernon. 25596.
Penicillin.—C. T. Calam, and I.C.I., Ltd. 25747.
Carboxylic acids.—Cilag, Ltd. 26001-3.
Penicillin.—Commercial Solvents, Ltd. 25787-90, 26223-28.
Extraction of casein from seeds.—Courtaulds, Ltd., and R. L. Wormell. 25746.
Tocopherol concentrates.—Distillation Products, Inc. 25906.
Vinylidene chloride.—Distillers Co., Ltd. C. A. Brighton, and J. J. P. Staudinger. 25597.
Streptomycin solutions.—Distillers Co., Ltd., P. D. Coppock, and A. G. White. 26322.
Ethylene oxide.—Distillers Co., Ltd., A. Dalgleish, J. B. Dymock, and D. R. Scarffe. 26321.
Vinyl ethers.—Distillers Co., Ltd., E. J. Gasson, D. C. Quin, and F. E. Salt. 25942.
Organic condensation.—Dominion Tar & Chemical Co., Ltd. 25627.
Paraformaldehyde.—E.I. Du Pont de Nemours & Co. 25953.
Melamine resins.—J. H. Earl, Ltd., C. A. Redfarn, and R. E. Barritt. 25673.
Dyeing.—A. S. Fern, C. A. Pulley, S. M. Todd, and I.C.I., Ltd. 26339-46.
Carboxylic acid compounds.—B. F. Goodrich. 25945.
Thiazine products.—B. F. Goodrich. 26121.

Complete Specifications Open to Public Inspection

Continuous process for neutralising fatty acids.—Procter & Gamble Co. February 23, 1945. 1694/46.
Process for the manufacture of metallic carbides.—Régie Nationale des Usines Renault. May 16, 1940. 22279/46.
Manufacture of hard alloys.—Régie Nationale des Usines Renault. May 16, 1940. 22280/46.
Production of hard alloys obtained by fritting.—Régie Nationale des Usines Renault. May 16, 1940. 22281/46.
Preparation of alloys by fritting.—Régie Nationale des Usines Renault. May 17, 1940. 22567/46.
Process for the manufacture of fritted alloys.—Régie Nationale des Usines Renault. May 17, 1940. 22568/46.
Process for the treatment of magnesium and its alloys.—Régie Nationale des Usines Renault. September 15, 1941. 22569/46.
Process of separating alloys.—Spolek pro Chemickou a Hutni Vyrobu. July 8, 1940. 23210/46.



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Preservation of organic materials.—M. Stern. August 5, 1944. 12135/46.

Catalytic reforming process.—Universal Oil Products Co. February 24, 1945. 5212/46.

Preparation of acetylpropyl chloride.—U.S. Industrial Chemicals, Inc. February 21, 1945. 33184/45.

Preparation of 5-diethylamino-2-pentanone.—U.S. Industrial Chemicals, Inc. February 21, 1945. 33185/45.

Heat-resisting alloys containing cobalt.—Allegheny Ludlum Steel Corporation. April 21, 1944. 23403/46.

Hard smooth craze-resistant surface coating.—American Cyanamid Co. March 2, 1945. 33049/45.

Resin for low-pressure paper base laminates and wood surfacing.—American Cyanamid Co. March 2, 1945. 34801/45.

Methods and apparatus for plying strands.—American Viscose Corporation. Feb. 23, 1945. 32865/45.

Production of phenolic resins.—Bakelite, Ltd. Feb. 27, 1945. 5859/46.

Production of cellulose derivatives.—British Celanese, Ltd. March 2, 1945. 5198/46.

Manufacture of azo-dyestuffs.—Ciba, Ltd. Feb. 27, 1945. (Cognate application 5998/46.) 5997/46.

Process and apparatus for the production of melamine.—E.I. Du Pont de Nemours & Co. Feb. 28, 1945. 6268/45.

Electrolytic production of light metals.—E.I. Du Pont de Nemours & Co. March 1, 1945. 6411/45.

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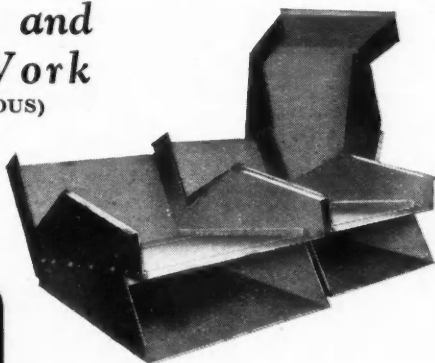
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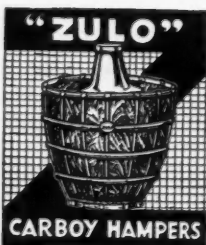
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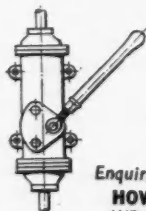
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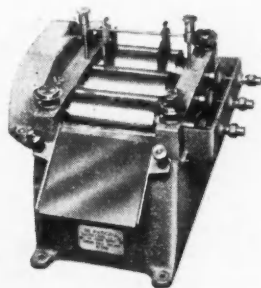
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